THE

LEPIDOPTERIST'S GUIDE,

BY

H. GUARD KNAGGS, M.D., F.L.S.

PRICE 1s. 6d.

THE

Lepidopterist's Guide,

INTENDED FOR THE USE OF

The Young Collector,

CONTAINING

FULL INSTRUCTIONS

FOR THE

COLLECTING, MANAGEMENT, OBSERVATION,

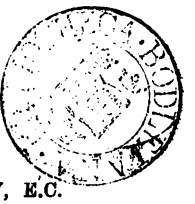
AND

PRESERVATION, OF LEPIDOPTERA,

In all their Stages.

BY

H. GUARD KNAGGS, M.D., F.L.S.



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1869.

To my Brother Editors

of the

Entomologist's Monthly Magazine

This Little Volume is inscribed

as a tribute of

Friendship and Esteem.

PREFACE.

Finding it impossible to publish the "Notes on Collecting" in the pages of the "Entomologist's Monthly Magazine," unless to the exclusion of matter contributed by our supporters, it has been determined to issue them in the present form.

The object of "The Guide" is to lead the young Entomologist, whether his tendencies lean towards mere collecting or to instructive observation, to reason for himself as occasion may require or suggest.

No originality is laid claim to, the facts and suggestions contained herein being already generally known and looked upon as a kind of public property. References have, therefore, been avoided as uselessly encumbering the book.

By using different types at the commencement of the more important sections and paragraphs, and, at the same time, printing a heading to each page, it is hoped that the necessity for an index will be dispensed with.

To Messrs. Charles G. Barrett, Frederick Bond, William Buckler, Henry Doubleday, the Rev. John Hellins, and others, who have rendered valuable assistance, his warmest thanks are due. Indeed, to Messrs. Hellins and Butler conjointly is attributable nearly the whole of the chapter devoted to observation in the caterpillar state. Mr. Barrett contributed largely to the hints on flowers and light; the chapter on colour is solely the production of Mr. Buckler; and the correctness of the botanical lists of allied genera is guaranteed by Prof. Boswell Syme.

The Lepidopterist's Guide.

THE EGG STATE.

"Ev'ry insect of each different kind,
In its own egg, cheer'd by the solar rays,
Organs involv'd, and latent life displays."
BLACKMORE.

Collecting.

There are two chief ways in which the eggs of *Lepidoptera* may be procured: the first, which has been termed egg hunting, is by finding them after they have been deposited naturally; the second is by allowing or inducing females to lay in captivity.

Egg hunting is a pursuit which from difficulties due to the small size of the objects, and the consummate skill with which they are frequently concealed, has hitherto scarcely met with that amount of attention which the subject deserves. While confessing on the one hand that the eggs of insects certainly are comparatively difficult to find, not only for the above reasons, but also from the facts that obviously they leave no tracks as larvæ do, and that being generally firmly attached, they are not to be shaken or beaten from their positions; yet on the other hand I cannot but think that continued and careful observation as to the situations in which eggs are deposited, the time during which the different species remain in the egg state, together with their appearances, disposition, and mode of concealment, would furnish results valuable alike to the collector, the observer of Nature's works, and to Science itself; and it must be admitted that the egg-hunter would sometimes stumble upon batches of such numbers as he could never hope to meet with in the other stages of insect existence, and that too of living embryo individuals hardly ever affected by parasites, unlikely to sicken from change of food and air, and not liable to droop and die from having received an unfortunate knock with the beating stick or unlucky dig with the trowel; besides, the fact that eggs *do* exist in almost infinitely greater numbers than larvæ, pupæ, or imagos, ought to stimulate us to overcome the difficulty.

The situations in which eggs are deposited are naturally either upon or in the neighbourhood of the food of the future larvæ, and almost

always in such localities as are adapted to the well-being of the species. A known or likely locality—that is one which, having the required food, has a similar soil, altitude, temperature, amount of moisture or dryness, shelter or openness, to one which the insect looked for is known to inhabit—must therefore first be selected as a spot for commencing operations. The collector will rarely stand a chance of finding upon a gravelly soil a species which is attached to the chalk or limestone, or a mountain species in the valley, or a heat-loving species in a bleak locality, a fen-insect on high and dry ground, or an inhabitant of a dense wood upon the open moors, &c.; though occasionally, by accident, as in the instance of females attracted to light, which have been known to deposit on the bars of the lamp, eggs have been found in such situations as cannot possibly afford a chance to the future larva. The more common positions of eggs are upon the surface and in the chinks of bark (frequently, unfortunately, high up on the trunk and branches), on twigs, buds, leaves, flowers and seeds, of various trees and plants; sometimes on neighbouring objects, as palings, walls, rocks, stones, clods; at others among refuse vegetable and animal matters; now and then loosely scattered upon the ground, or even fixed to aquatic plants beneath the surface of the water; while in some special cases the nests of ants, wasps, and bees, are the situations chosen by the parent female.

The time during which the different species remain in the egg state would very materially assist the collector, but little on this question has been chronicled; however, I think that, with few exceptions, the following may be adopted as rules:

Eggs deposited in early spring may be expected to hatch at about the time when the buds of the respective food-plants are ready to burst forth into leaf; but it not unfrequently occurs, even in Nature, that circumstances, which do not affect the eggs, retard the development of the food-plant, and the young larvæ are excluded before food is ready for them, in which case they generally pierce and feed within buds, catkins, &c., until such time as the leaves have become expanded, when, after feeding up in a variable time, they change to chrysalides, in which state the winter is passed. For ova of such we should therefore make search before the buds expand.

Eggs laid in spring and early summer usually hatch in a fortnight or three weeks, the species also feeding up and passing the winter in the chrysalis state.

Eggs deposited late in the summer and early autumn months in two or three weeks produce larvæ which feed up more or less slowly and frequently hybernate.

While *eggs deposited in the latter months of the year* do not usually hatch until the following spring.

It may here be well to mention a few special cases, namely, *double-brooded species*, of which there are two groups, "spring and summer brooded," and "summer and autumn brooded;" the eggs of both broods of the former group hatch quickly (in 10 days or so), the larvæ feeding up and changing to pupæ, in which state the winter is passed; the eggs of first batch of second group do likewise, but those of the last batch either do not hatch till spring, or hatching the larvæ hybernate. Some eggs laid in summer, as for instance those of *Cidaria dotata*, *C. prunata*, &c., do not hatch until the following spring. With other eggs there is sometimes the peculiarity of hatching at intervals, thus those of *Ennomos fuscantaria* seem to hatch at intervals of two or three days from the end of May to the end of June. Another exceptional case is that of *insects which hybernate in the perfect state*; these do not generally lay, or even pair, until the following spring.

Of course it stands to reason that eggs of butterflies and moths are laid during some period of the lifetime of the parent female, and that, therefore, when a species has been on the wing for a time, or more surely, if it be getting over, it is time to begin to look for the eggs; but, whereas some species deposit even directly after copulation, others do not lay until a variable, sometimes very considerable, time afterwards.

The appearance and modes in which the eggs of the *Lepidoptera* are disposed and concealed, present highly interesting points, not only to the egg-hunter, but to every thoughtful observer. That the eye should become familiarised with the general aspect of these objects as they appear in Nature is of the utmost importance to him who would successfully follow the pursuit of egg-hunting. Probably most of us are acquainted with the appearance of the eggs of many species, as for instance, the conical ridged egg of *Pieris Brassicæ*, the fluted barrel-shaped eggs of *Vanessa urticæ*, the pointed egg of *Gonepteryx rhamni* placed singly upon the terminal shoots of buckthorn, the large oval green egg of *Smerinthus populi* deposited singly upon poplar leaves, the masses deposited by *Zygæna* and *Zeuzera*, the latter in the chinks of bark, the fast-blackening globules of the female *Hepialus humuli* as she sows them broadcast, the pearly beads of the *Lithosidæ* and *Chelonidæ* neatly placed in batches (the beautiful egg of *A. villica* being iridescent like mother-of-pearl), the ringed egg of the Drinker Moth deposited on blades of grass, the batches of *C. neustria* and *E. lanestris* arranged spirally round twigs and coated over with protecting varnish, the colour-changing eggs of *Endromis* placed in small batches upon the twigs of birch, and of Saturnia on

heather, bramble and other plants, the somewhat cuplike-looking eggs of *Orgyia* coating the old cocoon of the nearly apterous female, the brown hemispherical eggs of *Dicranura vinula*, and the black drops of its small congeners *bifida* and *furcula* firmly fixed by their bases in groups of twos and threes upon the upper-sides of the leaves of willow and poplar, the pale drop-like eggs of the *Notodontidæ* sparsely scattered upon the leaves of their special food-plants, the ragged egg of *D. cæruleocephala*, the neatly-placed brick-shaped eggs of the genus *Ennomos*, the bottle-like eggs of *Selenia*, the small eggs of *Biston*, and those of *Boarmia* disposed of by the female in suitable chinks and crevices, the oval pearly eggs of *Melanthia* and *Cidaria* often so amazingly large when compared with the size of the parent moth, the scale-like egg of the *Tortrix*, and many others, which, when we come to know them well, will lead us to deduce analogies of the utmost assistance in previously forming an opinion as to where and what-like will be the egg of any particular species of which we may be desirous of going in quest.

And an examination of the anal segment of a female specimen would also afford us a means of making a fair guess at the situation and mode of concealment of its eggs. Thus—should she be provided with a longish protruded ovipositor, as *Zenzera*, *Cossus*, *Boarmia*, *Euperia*, the inference would be that the eggs would be found deposited deeply in the chinks of bark; should the abdomen be pointed with concealed or only slightly projecting ovipositor, as in some of the *Cosmidæ*, *Dianthœciæ*, *Hibernidæ*, *Eupithecidæ*, and other geometers, the probability would be that the species would deposit its eggs in flowers, or in axils of leaves, buds, &c.; should the abdomen be blunt, the eggs may be expected upon leaves, twigs, &c.; while, if the anal segment be tufted, the eggs will be found in patches, felted over with downy fur, and generally upon the surface of bark and twigs.

In searching upon trees, bushes, &c., it is advisable to carefully scrutinize each leaf, spot, stalk, and twig, from different aspects, which may be done by turning the branch under examination about in such a manner as to get successive views of the upper and under-sides of leaves, and the circumference of the twigs; it is also a good plan to look at the branch against a rather strong light, and the use of a powerful reading glass will increase our chances in about a proportionate ratio to its magnifying powers. Of course, whenever any unusual speck, spot, or patch arrests the attention, the collector must satisfy himself as to the cause of it. He will generally find that the under-sides of the leaves are the most favoured positions, but some species, as the *Dicranuridæ*, select the upper surface; eggs are most frequently placed near the

midrib and towards the apex of the leaf; the eggs of some moths are deposited in autumn upon the axils of leaves, and remain there through the winter, as for example those of *O. lota* and *Tethea retusa*, and from this cause thousands of these species are destroyed by the basket makers, who cut down the "witheys" in winter; the eggs of other species are placed on the buds, especially of the terminal shoots, as in the case of *G. rhamni*. The species which subsist on flowers and seeds, as most of the *Eupitheciæ*, *Dianthœciæ*, *Xanthiæ*, and *Erastria venustula*, probably deposit at the base of the petals or soft ovary, or on the flower stalks of Umbelliferæ, &c., as the case may be; the eggs of internal grass feeders will usually be deposited in or about the axil of the sheath around the stem, while those of wood and bark feeding species will generally be placed in chinks of bark, though *Sesia bembeciformis* certainly deposits naturally upon the leaves; the eggs of low plant feeders may be most likely detected on the under-sides of the leaves of their food-plant, on adjacent stems of grasses, or on other plants or objects in the neighbourhood.

The presence of the perfect insect, especially if a female have been noticed either at rest or on the wing, should of course at once put us on the alert; we may thus literally *hunt* for eggs while we follow the movements of the parent insect as she flits about depositing an egg here and an egg there.

For real instructive information, the eggs of all species should be diligently sought, and when found made a note of; and the foregoing remarks would seem to indicate that such proficiency might be attained as would enable the collector to pursue egg-hunting with great success.

The following plan, however, is a "moral," and exemplifies with amazing force the trite injunction "*Don't kill the goose for the sake of the golden egg.*"

Allowing or inducing Lepidopterous females to lay in captivity is a process well worth attention, and since it has been adopted by energetic breeders has well repaid the almost daily care which necessarily attend and follow it. Some species deposit freely enough, even when shut up in a pill box or impaled with a pin, requiring no inducement to the act; but many, unless properly managed, are apt to disappoint the collector's hopes in this respect. Among those which will be found to lay freely I may mention the *Smerinthi*, the *Hepialidæ*, *Lithosidæ*, *Chelonidæ*, *Liparidæ*, *Bombycidæ* (indeed, most of the true *Bombyces*), *Coremia*, *Hibernia*, *Cidaria*, and many other *Geometræ*, *Dicranura*, *Clostera*, and several *Notodontidæ*, *Acronycta*, *Xylophasia*, some of the *Tæniocampas* and *Xanthias*, the genus *Pyralis*, *Hydrocampa*, *Pterophorus*, &c.; others, on the contrary, require such inducements as space, admission of the sun's

rays, nutriment, presence of food-plant, suitable cracks and surfaces in which and on which to deposit, and other conditions which may from time to time suggest themselves to the observant Entomologist.

Butterflies, as a rule, require space, admission of the sun's rays, presence of the food-plant (especially of the flowers), air, &c., as incentives to laying; but some species, as *A. Galathea*, *Argynnis Euphrosyne*, *Paphia*, *Satyrus Ægeria*, *Hyperanthus*, *Chortobius Pamphilus*, &c., will generally lay freely enough if only the three latter conditions be complied with. Of sphinges, the *Sesia* will sometimes lay even after impalement, but *M. stellatarum* deposits its eggs while on the wing as it hovers, curling its abdomen forwards and upwards so as to place the egg upon the under surface of the leaf of its food-plant the bedstraw, *fuciformis* probably does the same upon the leaves of the honeysuckle, while some of the autumn species, as *A. Atropos*, *C. Celerio*, and *S. convolvuli* (generally supposed to deposit naturally after hybernation, though the latter has been known to lay fertile eggs in September), would also require space for flight.

Bombyces generally lay pretty freely; when shut up in a pillbox it is advisable to leave the lid a little on one side so that the enclosed insect may not be stifled, or the top of the lid may be knocked out and gauze substituted for it, and kept in place by the rim of it. The tongued *Bombyces*, as the *Lithosida* and the Hook-tips, should be allowed to sip from a sponge moistened with honey and water; and to the species whose females naturally deposit eggs in bright sunshine, as the day-flying Hook-tips, the sun's rays and air should of course have free admission.

Geometræ, as a rule, require nourishment, as afforded by the damp sweetened sponge, and some seem particular as to the surface upon which they deposit, one seeming to like deep chinks in rough bark or slits in a chip box, as *Nyssia*, *Biston*, *Boarmia*; another, as *Epione*, preferring a corner, such as that formed where the chip of the circumference of a willow box overlaps; a third, as *Cidaria*, depositing at the tips of any little projections from the surface, while a fourth is not satisfied unless she lays her eggs among some loose texture, as the folds of muslin, and so on.

Noctuæ more than all require the stimulus of the sweetened sponge, as they are a class of insects which are apt to delay oviposition until sometimes a very long period after impregnation, it not unfrequently happening that they die without depositing ova. In their case, as with the Geometers, we must first place the females in a suitable chamber, such as a child's toy box *loosely* lined with paper (for facility of the sub-

sequent removal of the eggs), and having a piece of gauze or leno substituted for the wooden top of the lid. The sweetened sponge may be pinned to the side of their cage, from which they will generally be found to sip freely; in order, however, to make sure of a female having a taste, place the sponge in front of her palpi and then very gently blow towards her, when she will immediately unfold her tongue and partake of the nectar.

It must be borne in mind that the males of some species, as *Bombyx*, *Saturnia*, *Endromis*, fly by day in quest of their respective females, but that the females do not generally fly or deposit their eggs until the evening has set in. As a rule the food-plant should be introduced to laying females, it can never do harm, and may sometimes be the means of procuring eggs otherwise unobtainable; and I may just note here that the introduction of a gas or lamp light to an apartment in which a female is depositing will, in most cases, stop the process, though in others this very means may be adopted as an incentive to lay; and it is sometimes noticed that a female with which every inducement had failed, has laid freely enough after having been treated with oxalic acid; and even the plan of actually squeezing out eggs from the body of a refractory female appears to have met with, at any rate, partial success in more cases than one.

It might seem absurdly superfluous to say that females only should be selected for laying purposes, but the remark is necessary, for a young friend once had the luck to capture a pair of a rarish prominent *in copulâ*, and whether or not the visions of innumerable bred specimens looming in the future turned his head I cannot say, but certain it is that he rashly converted his lady moth into a specimen, and waited with a patience worthy of a better cause for the cock to lay. It is, however, by no means the easiest job in the world to make out the sexes of certain species; in most cases the antennæ and the abdomen afford the required clue, but not in all: *ergo cave*.

Management.

Eggs should never be touched; when, however, for convenience it is necessary to remove them, as when found in Nature, or deposited in awkward or insecure positions in our breeding or other cages and boxes, the operation must be conducted with great care, and it must be remembered that the eggs of several species, as *H. croceago*, *A. prodromaria*, and others, are very soft when first laid, and that if the substance to which they are attached be even twisted or disturbed at this stage they will perish, but after a little time the shells harden, and they may then

with caution be removed by carefully cutting out the substance to which they are fixed; as a precautionary measure it has already been suggested to line the laying boxes loosely with paper or gauze, for the purpose of cutting out the bits upon which eggs may be deposited; these, on removal, should be placed in glass-topped boxes, which serve to secure the future larva from escape, and yet allow the owner to watch progress without opening or even moving the box. Beyond keeping them thus at ordinary atmospheric temperatures, as in an outhouse sheltered from the rain and sun, and daily watching them until such time as they hatch, no attention is necessary, unless in some rare instances it be advisable to damp them from time to time: with eggs which pass through the winter the chief precaution is, not to forget them in the spring.

A natural state of dampness may be kept up in the following way, as suggested by Mr. Hellins—a growing pad of the velvety moss, which flourishes on old walls, is placed, together with the food-plant, in a flower pot; the eggs are then sprinkled over the moss, into which they sink, and therefore cannot shift about.

Should it be desirable to get three broods of a double-brooded species, the Entomologist may, as soon as the food-plant is coming into leaf, either "force" the imagos by bringing the pupæ into a warm room, and so get eggs before the natural time, or he may hasten the hatching of eggs by a similar increase of temperature.

Fertile and infertile eggs may be known by the changes which take place in their colour, density, shape, &c.; the following may assist the egg possessor to a decision:—If an egg, from having been yellow or orange, change colour to any of the tints of pink, rose, or red; from having been of reddish colour to any hue of lavender, lilac, purple; from white, drab, or cream-colour to any shade of brown or lead-colour; from green to red or lurish purplish; or if an egg become black or uniformly darker, or if it get symmetrically marked, spotted, banded, or ringed, flatten or change form without shrivelling, the chances are that it is fertile, and that the natural changes are going on in the enclosed larva; but if, on the other hand, the egg should show transparency at one point and opacity at another for any length of time, or should go over its proper time of hatching, or should curl or collapse, it may almost certainly be considered either that the egg is unfertilised or that the contents have perished; for though the soft eggs of some species do shrivel to a certain extent, even though perfectly impregnated, it is assuredly, as a rule, a bad omen. Of course the above tests are inapplicable to eggs which, like those of the Puss-moth, have rigid, opaque, and coloured shells, but even here an adept will detect a difference between fertile and infertile ovum.

It will, however, be best for the collector to keep his eggs until he is quite sure about them, one way orother; remembering that the ova of the same species at one time may hatch in the autumn, at another may lie over until spring. Sometimes black specks make their appearance on the surface of eggs, especially upon the opâque white eggs of the *Prominents*, and are due to the enclosed larva having bitten through the shell so that the mandibles have become apparent. When this happens, the larva may be expected speedily to come forth; but it has often been noticed that, from some cause, the larvæ are exceedingly apt to die at this stage, probably from not having sufficient power to escape; damping with warm water and placing in a warmer temperature, as a hot-bed, may be worth trial, but I am perfectly satisfied that the usual plan of placing the eggs on the food-plant at this stage is often a fatal proceeding; on the whole, it is, perhaps, best to leave them to take their chance under the same circumstances in which they have been all along.

For transmitting eggs by post, two simple plans are generally adopted: the first and best is to punch or cut out a hole through a piece of wood, millboard, or other suitable substance, to fix a piece of card to one of the surfaces, thus forming a cavity or cell into which the eggs may be placed, and to cover over with another piece of card, which may be kept in position by a few turns of thread; this package may then be transmitted through the post in safety. The other plan is to procure quills (the penny or threepenny bundles of toothpicks sold at bazaars answer admirably), and, having paired them off straightly at each extremity, to accurately fit both ends with wooden stoppers, one of which being removed, the eggs may be inserted, the stopper replaced, and the thing is done, and the little package may be sent off in a letter; if several of these quills are required to be sent at once, they should be enclosed in a brass pen-box, a dozen of which may be purchased at a cheap rate (about 1s. 6d. or 1s. 9d.) of most stationers. Note—the advantage of using the wooden stoppers instead of wool, which is more generally employed for the purpose is twofold; the wood better resisting the stamp of the post office and not being liable to entangle the tiny prolegs of the larvæ should the eggs hatch *in transitu*.

Observation.

The observation of the eggs of insects is a subject of far greater importance than Entomologists have yet seemed willing to accord to it. In this vast field there is ample room to philosophize; these objects, representing, as they do, one stage in the existence of creatures which,

in their perfect state, we term and know as species, are necessarily as specifically distinct one from another as are the various moths themselves. It is, moreover, that stage of life in which, throughout all animal nature, the closest analogy exists; and bearing forcibly not only on that question of questions, the origin of species, but also upon the all-wise arrangements planned for their well-being and perpetuation, cannot fail to deeply interest every student of the laws of Nature.

The systematist might here find, sometimes at any rate, a help towards the classification of families and genera, by which, in course of time, we might hope for groups as natural as, for example, those of *Smerinthus*, *Hepialus*, *Lithosia*, *Arctia*, *Ennomos*, *Eupithecia*, *Tortrix*, and many others, the correctness of which is borne out by a reference to their respective eggs.

The nomenclator, too, might often form a diagnosis by aid of a comparison of the eggs of closely allied species; the Entomologist would have the pleasure and satisfaction of being able to recognize his species in the egg state; and even in a mercantile point of view, the architect and the artistic designer might profit, both in mind and pocket, by a study of their forms and exquisitely sculptured surfaces.

In carrying out observations upon the egg state, the student should note—

How the egg is laid: whether unattached or attached, or if so, by what means, and also by what part of its surface; the position of the female (and of her abdomen) at the time of laying—whether hovering, at rest, or in what other act; whether the eggs are laid singly or in batches, and if the latter, the number, and whether unarranged or how arranged; also the total number deposited, and whether nude or covered, and in the latter case how covered or protected, together with any exceptions, individual, special, natural, or abnormal.

When laid: at what date or dates, at what time or times of day or night, at what intervals, how long after copulation, and how long after emergence of the female, noting also exceptions.

Where laid: if not on the food-plant, where; if on the food, the exact position, as well as any exceptional instances which may come under notice.

The duration of the egg state, in species and in individual cases; *influences* of temperature, soil, locality, altitude, time of year, &c., which promote, retard, or modify the natural changes.

The appearance of the egg itself, as to form, colour or colours, markings, elevations, depressions, and sculpture on the surface, together with changes, normal as well as irregular, from the time of exclusion to that of hatching.

The mode of exit of the larva should be exactly observed, and any other remarks or experiments which may present themselves to the student, should, if possible, be followed up; such as, for instance, those of proving how long the egg state may continue (*i.e.*, the ovum retain its vitality), with a view to throwing light upon the at present hidden causes of the disappearance and periodical appearance of certain species; and of discovering if there be any sexual arrangement of the eggs, as laid, to account for the emergence of a preponderance of one sex of the future moth at one time, the other at another, from the same batch of eggs.

In describing, the best order will be to give the names of the parent species, and then, by the assistance of microscopical examination, the measurement, form, sculpture, colour, markings, and changes; arrangement of the eggs, time, situation, &c.; after which, a diagnosis from the allied species may be added, as well as any further remarks which may suggest themselves.

Preservation.

In the preservation of eggs, we must recollect that they are composed of an external membrane or shell of greater or less transparency or opacity, enclosing at first a white and yelk, and afterwards (if fertilised) a larva with appendages, and that the colours and markings are, in very many cases, principally due to the fact that the contents are dimly visible through the shell, for which reason these objects, when simply deprived of vitality and placed in collections without other preparation, change colour or shrivel, owing to alterations which take place in their interiors.

From the time of Swammerdam upwards, numerous attempts have been made to ensure a permanence of the natural aspect of these interesting objects, but I am not aware that anything like success has been achieved. Swammerdam's plan was the following:—Having first squeezed out the contents through a small punctured aperture in the shell, to inflate and re-fill, by means of a *very* fine glass blowpipe, with oil of spike, in which resin had been previously dissolved. Of course if the blowpipe were heated, or the operation conducted in a hot atmosphere, coloured wax, tallow, or cocoa-butter, would answer the same purpose; but, inasmuch, as opaque objects are not so readily examinable under the microscope, and as, moreover, the form, structure, and sculpture of the shell hold the chief places in the examination of these objects, it has been considered best that the shell alone should be mounted for the purpose; a mode of preparation which can be carried out with great facility, an

follows—Take a piece of leather, or other suitable substance, and having punched out a hole in it, fix it to the surface of a piece of glass; into the cell thus formed place the shell, and having covered it over with a disc of thin Venetian glass, ticket, and the mount is ready for the microscope, but doubtlessly, well executed coloured drawings would give the best idea.

END OF "EGG STATE."

THE CATERPILLAR STATE.

"Thus are my blossoms blasted in the bud,
"And caterpillars eat my leaves away,"
SHAKESPEARE.

Collecting.

With the exception of a few special manœuvres, larva collecting may be divided under three chief headings—searching—beating—and sweeping, which I now proceed to discuss in order.

Searching.—The only apparatus required for this purpose will be a goodly stock of boxes, either tin with perforated lids, or chip ones strengthened; for it is very annoying to find that some good larva has been smashed or liberated, from the box having collapsed under pressure or come to pieces from damp. The following appears to be the simplest, neatest, and most effectual way of rendering chip and pill boxes secure:—Cut strips of calico in a direction diagonal to the texture of the material ("on the cross," as it is termed), of about half-an-inch in width, and of the length of the circumference of the boxes to be operated on. Brush over one of these strips with shoemakers' paste (best for the purpose), and apply round the lid at the line where the two pieces of wood which form it are united, gently pulling the strip at the same time, so that, stretching in its middle line, it will adapt itself to the angular surface; then smooth down the calico on to the top and down the sides, and if the operation has been neatly conducted, it will be found that a smooth fillet, firmly encasing the angular joint of the lid, has been formed: and then prepare the bottom in the same manner. The disadvantage of the chip being comparative want of security and its food-drying nature, of the tin a tendency to cause the contained larvæ to, what is commonly termed, sweat, of these two evils the collector must judge for himself which is the least; on the whole, perhaps, chip will suit Noctuæ best, tins the Geo-

metræ. He will also require two or three large tin boxes, holding half-a-pint or so; a hooked stick, and a pocket-knife (or pair of scissors) will also be found most useful; and a botanist's collecting-box would enable him to bring home a plentiful supply of fresh food, though the ordinary chimney-pot hat of daily wear answers very well for the purpose and saves the extra burden.

Thus equipped, the larva-hunter having selected his locality, may proceed to work.

Indications of the presence of larvæ are numerous, and the collector will do well to keep an eye to them.

If a leaf be eaten it is usually a sign that larvæ have been the cause. But slugs, snails, wasps, leaf-cutting bees, &c., frequently eat or cut leaves in such a manner as to lead the inexperienced to believe the work to have been executed by larvæ; but when the molluscs have been the cause the leaves are generally *riddled*, and traces of their slimy trails and long string-like droppings are readily discernible, while the leaf-cutting of the Hymenopterous imagos is usually clean and of some neat shape, as oval, circular. Other mutilations of leaves, as those caused by animals, birds, friction between contiguous branches, rupture from force, such as that of the beating-stick or pelting hail, &c., present a bruised appearance unlike that produced by the feeding larva. If, however, the edges more particularly have been devoured and the ribs more or less completely demolished, it may, as a rule, be set down as the work of a Lepidopterous larva; whereas, if the centre of the leaf be attacked, the ribs being avoided, it looks rather suspiciously indicative of saw-fly larva, though by no means necessarily so, for the young larvæ of many Lepidoptera feed much after the same manner; and case-bearers seem almost invariably to attack the centre parts of the leaf.

If the parts eaten present a fresh appearance, the larvæ, in all probability, will not be far distant, and diligent search should be made for them; in this way it is by no means difficult to track the larvæ of many of our Sphinges, most of our Bombyces and Pseudo-bombyces, as well as of several Geometræ, butterflies, case-bearers, &c. The search must be effected by turning the branch or stem in such directions as will enable the collector to see in succession all parts of the leaves (especially of edges and midribs), leaf stalks, twigs, and the bark of the branch itself; indeed the procedure is the same as that which has been ecommended under egg-hunting, excepting that here we have a more certain clue as to the presence of the object of our search. In very important cases it may even be desirable to pluck off and examine

attentively in succession leaf after leaf, twig after twig; but I have some hesitation in recommending this plan, which has an air of wantonness about it.

Whenever two or more leaves are spun together, or when a shoot is unable to expand, or a leaf is folded, the hunter should at once proceed to unravel the cause, which will most frequently be found to be Lepidopterous, and would indicate that a larva or larvæ were, or had been, feeding between or within. In this manner feed the larvæ of *Clostera*, *Cymatophora*, *Tethea*, *Dicycla*, *Cosmia*, *Epunda viminalis*, *Cheimatobia*, *Ypsipetes elutata* and *ruberaria*, *Melanippe hastata*, *Eupithecia debiliata*, *Scotosia* (when young), some species of the genera *Pyrausta*, *Botys*, *Pionea*, and *Scopula*, also some of the *Phycidæ*, *Halias chlorana*, and a vast majority of the *Tortrices*. As many of these larvæ, however, have a knack of wriggling from between the leaves on the slightest handling of the "leafy hut," a net should be held beneath preparatory to securing them. When only two leaves are drawn together the contained larva may usually be discovered by looking through them against the light, when of course there will be no need to disturb them. When the bunches are composed of more than two leaves, one or two may be opened to ascertain whether or not the larva be present, and of the proper growth for being collected, when, if the result be satisfactory, the spun leaves should be cut off and placed in the tin box without further examination.

A withered or sickly appearance of the food-plant often denotes the presence of an internal stem or root-feeding larva, and by attention to this point the practised eye will detect at a glance an infected plant amongst a number of healthy ones. Thus, when the centre leaves of reeds die off, the presence of the larva of *M. arundinis*, *N. geminipuncta*, *Helmanni*, *Ch. forficellus*, or *S. ulvæ*, even possibly of *M. flammea*, may be suspected; the larva of *C. sagittata* bites through the stems of *Thalictrum*, and then feeds on the leaves thus caused to wither, and so, too, similarly, does that of *Pterophorus hieracii* on *Teucrium*. When the flowers of thistles have an abortive appearance, some internal stem-feeding larva is generally the cause; the sickly appearance of *Echium* plants on the coast indicates the whereabouts of the larval *Odontia dentalis*; and as further examples, I may mention *Sesia chrysidiformis* (dock), *philanthiformis* (thrift), *Leucania littoralis* (at roots of *Ammophila arenaria*), *L. phragmitidis* (reeds), *Nonagria cannæ* and *N. typhæ* (stems of *Typha latifolia*), *Gortyna* (*Arctium lappa*, *Scrophularia*, &c.), *Hydræcia* (roots of *Tussilago*, *Cyperaceæ*, &c.), *D. templi* (*Heracleum*), *O. antiquana* (roots of *Stachys*), *Argyrolepia* (roots of various plants), *E. virsiana* (stems of thistles in woods), and *scutulana* (ditto in open places).

This aspect of the plant is not unfrequently accompanied—in the

case of stem-feeders at any rate—with a spot on the stem at which the larva had originally entered; after one or two stems or roots have been inspected, and the hunter is assured that the larva of a Lepidopteron is the cause of the drooping of the plant, then if the stem be the affected part, it should be cut off considerably above and below the position (as ascertained by experience) of the contained larva, and afterwards kept stuck in damp sand; when it is the root which is affected, the stem may be cut off low down, the roots pulled up, and placed in sand.

Flowers or buds drawn together, or otherwise distorted or notched, should be carefully examined (as indeed should be the flowers of all special food-plants), when the cause will generally be detected without difficulty. The larva may be simply feeding openly upon the flowers, as, for instance, "a shark" on golden rod or mullein; it may be concealed, as *Diantheecia* and *Eup. venosata* in the capsules of *Silene*, *Lychnis*, and *Dianthus*, or *Eup. tenuiata* in sallow-bloom, while *Ep. viminalis* and *Y. elutata* will sometimes spin together two or three female catkins, and so conceal themselves; it may hide itself by day, as *Triphæna fimbria*, which feeds by night on flowers (by choice) of primrose and other plants; or larvæ may spin a web within a flower head, as *Spilodes palealis* in the umbels of *Daucus carota*; or it may feed openly in the bright sunshine, as in the case of the members of the genus *Cucullia*, on mullein, water-betony, golden rod, wormwood, and chamomile respectively. Other instances of species whose larvæ show preference for flowers are *Lycæna argiolus*, on holly and ivy; *Eremobia*, on grasses; the two *Hecatera*, on sow-thistles and other *Compositæ*; young *Xanthia* larvæ in sallow catkins; *Erastria venustula*, on tormentil; most of the *Heliothidæ*, on *Ononis*, *Erodium*, *Hyoscyamus*, &c.; a large proportion of the *Eupithecia*, chiefly on *Umbelliferæ* and *Compositæ*; *Larentia cæsiata*, on whortleberry; the genus *Emmelesia*, on various flowers and seeds; *Anaitis*, on *Hypericum*; several *Tortrices*, and (though I refer the reader to Mr. Stainton's "Companion" for information respecting *Tineina*), *Depressariæ* and *Gelechiæ*.

Other flower-heads, seeds, &c., even though presenting no outward sign, are so apt to contain larvæ, that the simple fact of their presence may be looked on as an *indication* of the probable inhabitants, as *A. gentianana*, in the pith of dry teasel heads; *Eup. roseana*, in the seeds of the same; *D. pisana* and *nebritana*, in pea-pods, and many others. All that is necessary is to collect the catkins, fruits, seeds, and pods, and place them in a suitable breeding cage, such as a common scaleboard hat-box, into the lid of which a piece of muslin has been inserted for ventilating purposes.

Fruits, seeds, &c., which fall before they have ripened, unless the

weather be very tempestuous, generally contain some larva, frequently of the family *Tortricina*, as *Carpocapsa pomonana* (apples); *C. funebrana* (plums and sloes); *C. grossana* (beech masts); *C. splendana* and *juliana* (acorns); and of course *Eup. tenuiata &c.*, (in fallen sallow catkins). These should be collected at the time of falling as quickly as possible, for the *Tortrix* larvæ soon quit the fruit to spin up elsewhere.

Tumid twigs, rough unnatural appearance of bark, holes in the boles and branches of trees, &c., usually denote the presence of larvæ, sometimes of *Lepidoptera*, sometimes of *Diptera*, sometimes of *Coleoptera*; at one time of a wood feeder, at another of a bark feeder. As examples, let us take the unmistakeable signs of the wood-boring *Cossus* in its ravages on willows and various other trees, and *Zenzera* in ash, privet, apple, lilac, &c.; *Trochilium apiforme* and *bembeciforme* in aspen, sallow, &c.; *tipuliforme* in nodulated twigs of currant-bushes; *cynipiforme* in the bark of unhealthy looking oaks; *sphegiforme, scoliæforme*, and *culiciforme* birch and alder; *culiciforme* seeming to prefer the stump of a tree which has been felled, so that it is advisable to search these stumps on the next year after the trunk has been cut down; *myopiforme* in bark of apple and pear trees; *formiciforme* in osier twigs; besides a few *Tortrices*, such as *S. Wœberana* (apple and pear) and *P. oppressana* (poplar; also *Ephestia pinguedinella*, which, by roughening the bark of ash, and ejecting "frass" at the opening of its galleries, betrays its whereabouts.

The smell, as of the *Cossus* larva, so strongly inherent in the animal (for aught I know existing in other larvæ), would indicate its proximity, and the hunter, if it please him, may "follow up the scent."

The sound of the jaw-work of the larger larvæ, as those of the *Sphingidæ* for instance, or of falling frass, might assist us also to their situations.

Webs, whether on trees, bushes, or herbs, frequently indicate the position of a colony of larvæ; the collector having satisfied himself that the contained larvæ are Lepidopterous, and worth the trouble of rearing, should take nest and all, as the web seems in some measure to be necessary to the welfare of the species, affording as it does a place of retirement for the larvæ when not engaged in the work of defoliation.

Single silken threads hanging from branches, or wherever else observed, often have a larva at the end of them; when they extend to the ground, the threads should be jerked up so as to lift the larvæ, or they may be tracked to their destination.

Cast-off skins are sometimes noticed on the leaves of plants, &c.; when the skins are soft and fresh the larvæ usually are not far off.

But frass (a word derived from the German, and used here to express the pellets of excrement,) next perhaps to the abnormal appearances of

the plants themselves, is one of the surest signs to go by. Upon the sand hills, chalky places, paths, roads, or other places where ground vegetation is scanty, we may frequently find these evidences, and from them, bringing a knowledge of the laws of gravitation to our help, make a shrewd guess at the position of the larva; we can, thereby, also form an opinion as to the size of the larva, and even in some cases as to the very species (e. g. *D. galii* and *M. stellatarum*), while from its fresh or stale appearance we may calculate the chances of the larvæ being in the vicinity; by this, aided by trails, often has the larva of *Deilephila* been successfully tracked.

The Trails and burrowings of larvæ as of *Deilephila*, *Agrotis*, and others, indicate the direction which they have taken, and these too may sometimes be followed up with advantage.

The presence of ichneumons and birds, such as Tomtits, Tree-creepers, &c., would also point out that their prey, and our game, was in the neighbourhood.

The situations *and modes of concealment* of larvæ vary very considerably, even in individuals of the same species, according as they happen to be feeding, moulting, or reposing, some remaining attached to their food, others forsaking it at times to shelter elsewhere, the latter being the rule with the largest proportion of night-feeding *Noctuæ*.

Of Butterfly larvæ some, as those of the well-known "garden whites," feed and repose openly and exposedly upon their food-plants; others, which are more or less onisciform in shape and green in hue, generally attach themselves in repose to the mid-ribs on the under-sides of leaves, where they should be sought for on their special plants; a third set conceal themselves when at rest under the lower leaves of their food-plant, or on neighbouring objects; while the gregarious larvæ of some of our *Vanessidæ* remain more or less hidden in their webs.

Sphinx larvæ: some of these feed openly, and usually hold firmly to their positions, not forsaking their food while resting; I may instance those of the *Smerinthi*; others, as the larvæ of *A. atropos* and *S. convolvuli*, hide away under sods, &c., when not occupied in feeding; but the internal wood, bark, and stem-inhabiting *Sesiidæ*, of course, do not quit their tunnelled habitations.

Bombyces have various habits in the larval state, some, as the low-plant-feeding "tigers" and "ermines," feed openly in the day-time, and especially during the hours of morning sunshine, hiding away under leaves, sods, stones, or amongst rubbish, when not so engaged; some clinging closely to stems, twigs, or leaves; several colonizing in webs, and a few feeding internally, &c.

Geometric larvæ, whether feeding, reposing, or moulting, usually remain fixed to some part of their food-plant, as also do the *Pseudobombyces*; those of *Clostera*, however, spinning together leaves, as a means of protection and concealment.

The larvæ of Noctuæ are more inclined to roam, when they are not exerting their masticatory powers; on such occasions they may not unfrequently be found sheltering under stones, logs, sods, rubbish, loose bark, in the chinks of bark, amongst dead leaves or ground herbage, in cut-off stems of reeds, and sometimes below the ground, those of *Leucania littoralis*, *Agrotis ripæ* and *præcox*, actually burrowing to the unusual depth of seven or eight inches in the sand; others again live between leaves, as *Cymatophora*, *Tethea*; in catkins, as young *Xanthiæ*; in capsules, as *Dianthæcia*; a third class feeding openly and in the bright sunshine, as the *Cucullias*; and, while not a few, as the genera *Nonagria*, *Hydræcia*, *Miana*, *Dasipolia*, &c., are to be met with in the stems of *Graminaceæ*, *Cyperaceæ*, *Cynarocephaleæ*, *Umbelliferæ*, and other families of plants, *Bryophila* constructs artful lichen-covered places of retreat, and so on.

The instinct and skill displayed by larvæ in selecting such situations as will, from colour or form, render them less open to observation is frequently remarkable, and necessitates very careful searching on the part of the hunter; he will, however, be most materially assisted in his search by blowing upon the branch at first gently, and with net held beneath, for such larvæ as drop under this kind of treatment; and afterwards more forcibly, by which the tightly-holding larvæ are compelled instinctively to curl up their segments, erect themselves, or otherwise alter their postures, and so, perchance, betray their presence.

Examples of caterpillars "mimicking" different portions of their food and other objects are by no means of uncommon occurrence. That of *S. populi* greatly resembles a leaf of willow, upon which it is frequently found feeding; the respective larvæ of *G. quercifolia*, *P. populi*, and *E. fasciaria*, when in repose lie at full length, flatly pressed upon a branch or twig, to which, moreover, their colour often so closely approximates, that they are with difficulty discovered, the apparent turnidity of the twig being readily passed over; the larva of *Cidaria silaceata* greatly resembles the seed-pod of the *Epilobium*, on which it feeds; that of *G. papilionaria* looks, in repose, much like a birch catkin. Many geometric larvæ assimilate in a wonderful degree to the colours and forms of the twigs, stems, or leaf-stalks of their food-plants; and Mr. Birchall has remarked that the coiled up larva of *Lithosia caniola* is not unlike a little snail-shell, which is abundant in its native haunts.

And so, the collector's hope of becoming a successful larva-hunter

lies, in a great measure, in his aptitude for acquiring an extra kind of sense—a power of *discriminating* these living animals from vegetable environings—a power only to be obtained by experience on the hunting ground.

Times of year.—Necessarily, larvæ may be taken all the year round; but, inasmuch as the hunter will stand a better chance of "making a bag" at particular seasons, it may be as well to mention the more profitable times in which to pursue his occupation.

Firstly, as soon after winter as may be convenient, it will be advisable to collect, at favourable localities, quantities of fallen leaves; and, having placed them on a sheet, to knock them about in order to detach any hybernating larvæ which may be present. The French say that, though this method is rather chance-work, the larvæ of many of the rarer *Noctuæ* are sometimes to be got in plenty by the process; at any rate it is worth trial; nor do I doubt but that indoor examination of sackfuls of dead leaves and moss from likely localities; rubbish, soil, tufts of plants (roots and all), especially from our heaths and sandhills; herbage gathered from favoured banks and slopes, &c., would be most productive, not only in the matter of hybernating larvæ, but of other prizes, and amply repay the trouble of collection and the expense of transport.

About this time also loose bark may be detached (by means of a lever such as used by Coleopterists); earthward-looking surfaces, the bottoms of stacks and ricks, whether of faggots, heather, gorse, beans, reeds, straw, or hay, &c., should be poked about and investigated; barns, out-houses, garden frames and pits, inspected; thatched and other roofings beaten; stones, logs, sods, &c., turned over; chinks and crevices in trees, posts, pales, and walls, peered into; tufty plants, (as grasses, storks-bill, primrose, garden pinks, and the like) and tangled herbage turned up, shaken, and both they and the surface of the soil beneath them carefully examined, and indeed every conceivable hybernaculum should be hunted up, not forgetting the nests of *Hymenoptera* (especially deserted ones) for the *Gallerida*.

After continued heavy rains in February, there generally ensues a mild night or two, without a breath of wind, and the ground being saturated with moisture, the atmosphere becomes foggy; these are the nights to be looked for, and seized by the collector of larvæ, for though many (or most) of the species he may meet with will be of small size, some can then be found which he is not likely to capture in a more matured state; when, therefore, such opportunities occur, the known spots in woods, such as openings, clearings, burn-patches, &c., should be *visited soon after dark*, and all the dead stalks and blades of dry grass

(for in woods no new herbage is as yet visible,) examined, on which will be found numbers of larvæ, stretched out as if to enjoy the soft air on waking from their winter sleep. One such night in February is often more remunerating than a dozen a month later, for many species, whose natural habits keep them close to the roots of grasses, seem on such occasions to evince a desire to rise and survey the aspect of their locality. On such a night, Mr. Buckler assures me he has taken larvæ in the greatest profusion, and indeed on one occasion, sought for, and found no less than 173 of various kinds.

On the arrival of verdure to the vegetable kingdom, larval life begins to put in an active appearance, hybernated species coming forth from their winter quarters, and newly-hatched ones from their egg-shells; of the former, some may be found on weedy banks, feeding or basking in the spring-tide sun-rays, others on warm evenings freely exerting their jaws on newly expanded buds of trees, bushes, &c., or discussing the leaves of "various low plants." Thus in the spring of the year, the larvæ of many butterflies, several *Bombyces*, *Ourapteryx*, *Pericallia*, *Boarmia*, *Geometra*, and some of the other Emeralds, *Acidalia*, some of *Larentia* and *Melanippe*, *Bryophila*, *Leucania*, *Xylophasia*, *Heliophobus*, *Miana*, *Triphœna*, *Noctua*, *Aplecta*, *Mania*, *&c.*, may be found after hybernation feeding by night, as well as the small fry aforesaid. The latter (the small fry) are generally to be found at home upon their food, from which, upon the slightest jar or approach of danger, they lower themselves by silken threads, and could be readily collected at this period of their existence with the almost certainty of their being free from the stings of ichneumons. Most collectors, however, do not care to capture them at this stage, preferring to wait until at the end of May or beginning of June, they have advanced in growth, are more distinguishable, one species from another, and require less time and care to feed up.

After this, caterpillar life begins to wane and collecting the perfect insect becomes the pursuit of the Entomologist, until again, towards autumn, vegetation once more abounds with larvæ, many of which, particularly the smaller geometric ones, and those of *Noctuæ* whether large or small, hybernate.

Times of day.—Much depends upon whether it is desired to capture any given larva whilst feeding or reposing; the great feeding-times of the majority (as of *Noctuæ*, *Geometræ*,) being just after sun-set, and again in the morning when the leaves are bathed in dew (a wholesome condition of things which seems to give a zest to the food); but some, as *"Sharks," evidently* select the bright hours of sunshine for their meal *times; the hairy Bombyces* prefer the morning sun; and other larvæ

feed, on and off, through either day or night, or both. Some night-feeding larvæ which leave their food to seek repose may be sought for in the day-time; thus, in their haunts, those of *L. monacha*, *M. aprilina*, *T. munda*, and the genus *Catocala*, are often found hiding in the crevices of bark of oaks, willows, and other trees, or under semi-detached pieces of bark.

Searching by night is conducted much after the manner of day-work; but a lantern, to aid vision, is required, and a net (or substitute for it) becomes an important auxiliary for holding under the bushes examined, in order to circumvent such individuals as drop under the stimulus of light or man's interference: for which reason the lantern should be darkened until the hunter is quite prepared to commence his search. At night too the trunks of trees should not be neglected, as larvæ will frequently be found crawling (swarming I might say in the case of some *Orthosidæ*) up to regain their food. Whilst "sugaring" also, an eye should be kept open for such larvæ as may be attracted; and the blossoms of certain trees and shrubs, as the elm, oak, sallow, and arbutus, seem to allure many larvæ, most of which however probably feed naturally on these plants.

For ordinary night searching the following trees, shrubs and herbs will be found among the most productive:—birch, elm, oak, black-thorn, white-thorn, sallow, bramble, (especially the young shoots), heath, dock, plantain, persicaria, geum, violet, ground-ivy, various grasses, &c., &c., but all plants should be inspected, and when search has to be made for any special larva, a previous acquaintance with its natural food is necessary.

Capturing is usually an easy job, the collector simply cutting off the leaf or twig with the larva attached, or gently picking off the latter and placing it, together with a sprig of the food, in one of his boxes, taking care not to overcrowd his captures, and keeping a sharp look out for cannibals, such as *Scopelosoma satellitia* and the blood-thirsty *C. trapezina*, with whose appearance he should early familiarise himself. For those larvæ which drop upon the least touch, a box or net should be held beneath. Some, as for example those of *Cucullia*, actually jump, jerk, or wriggle with such alacrity, as to render their capture a matter of difficulty; in such case, the collector must either be ready with his net, or prepared to catch them dexterously in his hand as they fall, and so ensure their transfer to appropriate boxes.

Traps for larvæ may be worth trial. The gardeners' plan of sticking cones of paper or little inverted flower pots about the plants has been recommended and seems to answer in the country, but near London

I am persuaded that the catch (or "no catch,") would mainly consist of *Euplexoptera* and *Mollusca*. For such larvæ as desert their food, to repose or hybernate, folded pieces of old flannel or carpet may be spread upon the surface of the soil in likely places with a probability of success.

As a bait I am not aware that any substance, barring the questionable one of sugar, has been found attractive; but as the smell of "iodine" is said to cause slugs to congregate (not that slugs have anything in common with larvæ), it is not impossible that a discovery of the kind may be made. It has been noticed, however, that many herbivorous larvæ are remarkably fond of *lettuce*, and it has therefore been found worth while to scatter lettuce leaves over the hunting ground some hours before our search for larvæ.

Beating is the next mode of collecting which comes under consideration.

The apparatus ordinarily used, consists of a clap net (the larger the better) or an umbrella, or still better, an ingenious invention of Mr. Norcombe's, which is carried out in the following simple and inexpensive manner:—Two pieces of cane (or lath) are "hemmed" into opposite sides of a piece of window blind, and through a hole made in the middle of one of them a loop of string is passed. Now for use:—Take an umbrella net (such as used for "sweeping,") open it, slip the loop over the ferrule end, unfurl the blind over the net, and hold down the other cane by means of the thumb of the left hand. Thus not only is a large surface afforded for receiving the results of his beatings, but the collector may instantaneously detach the appendix, leaving him, net in hand, free to chase any insect which may suddenly start up. Then a beating stick, such as a heavy hook-handled walking stick will be required, and as many boxes and tins as the beater can conveniently manage to stow away in his pockets or satchel: it may be here noted that a handy box is thus formed:—Take a chip box and put a second lid on the bottom; punch, or cut, a hole through the second lid *and* bottom, towards the circumference:—when the holes thus formed are opposite to one another, larvæ may be inserted, but when the second lid is shifted round, the holes are not opposite, and there is no opening.

The form of larva tin best suited for the pocket is "oval," size optional, the bottom being perforated and the lid provided with a short tube into which a cork is fitted:—Larvæ are easily put down the tube and the danger of crushing them, by removing and replacing the lid, is obviated. For working the higher branches of trees a large surface of *canvas or other material*, and a long pole for beating become necessities,

and an iron crook, whipped with waxed string to the top of the pole, is very useful for suddenly and forcibly shaking the upper branches; as the larvæ, thus detached, fall straight down on the sheet below; the sheet is also of the greatest use where any large extent of tall bushes has to be beaten or shaken.

Saplings may be jarred by kicking against them with the heel, but both they and the lower branches of trees are best worked by means of the mallet ("*le maillet,*") that is an ordinary mallet, the striking-end of which is loaded, with from a quarter of a pound to two pounds of lead, and encased in stout leather or gutta percha, which has the double effect of preventing, in a great measure, injury to the trees, and diminishing sound; it is an instrument much in vogue with our French neighbours, to the efficacy of which I can myself attest—a light one, with a longish handle, is most suitable for the kind of work mentioned here. In using this implement it must be remembered that our endeavour is not to thrash the larvæ off the food, but rather to jar or shake the food from their foot-hold, and therefore, after administering a gentle tap or two for such larvæ as fall readily, we should *strike sharply and suddenly in the direction opposite to that in which we desire the larvæ to fall,* otherwise most of them will be jerked away and lost, though even with the greatest care it is difficult to entirely avert the occurrence.

The beating-stick is most serviceable for ejecting larvæ from bushes, and this is generally wielded in the right hand, while the left is employed in holding the clap net, umbrella, or "what-not," in the most advantageous position for receiving the results of the beating. Although most people think the direction in which they apply their beating-sticks unimportant, my friend Dr. Wallace will tell them that, unless they attend to the above italicised sentence, they will labour with little chance of success for the larvæ of *Aleucis pictaria,* and other clinging geometric larvæ.

From time to time the "beatings" should be carefully examined, and such larvæ as the collector desires to retain boxed with as little handling as possible. The contents of the net should then be turned about, and blown, or smoked, upon with a view to rendering active such larvæ as may have instinctively coiled up or become otherwise inert from the suddenness of the shock which has dislodged them: when the collector can find no more, he should cautiously turn out the contents, and cast a last lingering glance over the net or umbrella for any larvæ which may have attached themselves to the fabric of the receptacle.

Whilst beating by night the operator will act wisely to eschew the *use of a lantern,* which would certainly do more harm than good, as the

tendency would be to "scare" many larvæ; he will, however, of course require it when examining the results of his beating.

Shaking is sometimes preferable to beating bushes, as for example in cases where it is desirable to procure the larvæ of certain species without injuring them, or to tire out such as those of *Apatura*, *Dicranura*, *Notodonta*, *Petasia*, for which the beating-stick has no terrors, and whose grip seldom relaxes for anything short of a mortal wound or blow.

In shaking bushes, spread the sheet beneath, grasp in each hand a large stem, pull towards you, give as strong a downward jerk as strength will permit of, and keep on repeating the process. I need hardly say it is tough work. Shaking is also the more effective plan of working herbs, beating being hardly applicable), and is effected by gathering in the hand a head or bunch of the plant, bending it down, shaking it over the umbrella or net, and striking it against the stick or ribs.

Fumigation *and vaporation*, applied to bushes, whether by means of the smoke-bellows, in the form of tinder and tobacco smoke, or by Maw's Atmospheric odorator, or Dr. Richardson's apparatus! in the form of a cloud of Benzine, solution of Carbolic acid, Naptha, or other pungent fluid, would I dare say astonish the inmates, and doubtless cause their precipitate retreat. Never having tried the plan, however, I cannot speak with that amount of certainty which I hope to be enabled to do on a future occasion; fumigation has, however, been employed as a means of disquieting the larval occupants of low herbage, with, at any rate, some amount of success.

Sweeping is undoubtedly the best plan for obtaining the inhabitants of low-ground herbage, in fact the number of larvæ, of species otherwise far from common, which may thus be taken is often perfectly surprising: it may also be used for working bushes, but for this purpose it scarcely comes up to beating.

The apparatus required consists of the usual complement of tins and boxes, and a sweeping-net, a coleopterist's will *do*, the frame of which is formed of a ring of stout steel wire, (joined or hinged for convenience of doubling up and pocketing,) which screws into a rather long handle, and the bag of the net should be made of "Cheese Cloth," the hem through which the ring passes (easily) being composed of leather. This answers very well for *sweeping*, but for the Lepidopterist, who is (or *ought to* be) always having insects fly up under his very nose, it is rather *too heavy: Mr. Cooke*, of New Oxford Street, has however acted on a

hint I gave him, and now produces, at a reasonable rate, an umbrella sweeping-net of such strength as to defy breakage, and yet sufficiently light to permit of easy aërial manipulation. The operator, as he advances step by step, makes long steady sweeps of the net alternately from right to left, and back again from left to right, much after the movements of a mower, except that the sweeper mows, as it were, both ways, a very little practise enabling him to acquire the requisite turn of the wrist whereby the contents are retained within the net.

By day many larvæ may thus be obtained on the slopes of hills and undercliffs, particularly such as have a good assortment of wild herbs, along banks and ditches where herbs and weeds grow rankly, &c.

Just before sunset, however, is, as with beating, the grand time to begin sweeping, when our heaths, moors, sandhills, banks, rides in woods, and other "canny" places, teem with larvæ, affording abundance of sport, especially on warm summer evenings in the spring months.

When the vegetation swept is of an uniform character, as heather upon a moor, bilberry on a "chase," reeds, rushes, &c., in a marsh, or clover in a field, much time will be saved by putting the whole of the "sweepings" *without examination* into a closely fastening bag, for future leisurely investigation at home:—By this means, in addition to the time saved, the necessity for a lantern is done away with, and *Psyche* and *Coleophora* cases when present will be got sometimes in plenty—besides which sawfly larvæ, beetles, *Hymenoptera* and bugs, as well as spiders, may be saved, without trouble, for friends or fellow-labourers whose spécialité leans towards them, and who may at some future time in gratitude for your services, mention you honourably in some great monograph or other.

To give an idea of the returns to be anticipated from an evening's work, I may remark that it is by no means unusual during a favourable evening towards the end of May, upon a heath or moor (as in the hollows at Shirley), to meet with larvæ of the following in greater or less abundance: *Agrotis agathina* and *porphyrea*, *Noctua neglecta* and *Dahlii*, *A. myrtilli*, *P. hippocastanaria*, *A. strigillaria*, *F. atomaria*, and *belgiaria*, *Eup. minutata* and *nanata*, &c., besides the heterogeneous *pôt pourri* before mentioned.

On reaching home we should lose no time in looking over our sweepings, and this is the *modus operandi*.—Unfasten the bag, shake out a handful or so into a large white meat-dish, and having tied up the bag again and distributed the sweepings over the surface of the dish, proceed to examine; put the Lepidopterous larvæ into glass-topped jam pots, in *which fresh sprigs* of the food-plant have already been placed; the

beetles into a laurel bottle ticketed "*For E. C. Rye;*" the bugs into another "*For John Scott;*" pin the *Hymenoptera* "*For F. Smith;*" and immerse the spiders in a bottle of proof-spirit "*For the Rev. O. P. Cambridge:*"—repeat the process until the sweepings are exhausted, placing them after each examination into what is known as a "sixpenny pan," which tie over with muslin; for days after *Coleophora* will (and *Psychidæ* would too, if present) come up and attach themselves to the muslin, where that may be instantly detected. NOTE.—This is the way I should set about obtaining the cases of *Psyche nigricans* and *opacella*, as well as other low-feeding case bearers.

With three lines of advice to the larva-hunter, I close this chapter on collecting:

1. Lose no time in making out the species to which your captures belong.

2. Do not think that, because you find a larva in abundance, it necessarily pertains to a common species; or the converse.

3. Do not expect to breed one tythe of the larvæ you obtain by beating and sweeping and you will not be dissappointed.

Management.

Many an Entomologist who has of late years devoted both time and energy to 'breeding,' as it is termed, will bear me out in the statement, that it is perhaps the most deeply interesting of all the charming occupations of the student of Entomology—for, whether we regard it in an instructive point of view, or pursue it from the simple love of contemplating Creation's wonders, or whether we have an eye merely to quantity and quality of 'specimens,' it is in either case an equally profitable employment.

The first thought which probably strikes the collector is that Nature herself must be the best nurse, and that to follow her will therefore be the *summum bonum* of breeding; but, though for truthful natural histories and accurate records of the œconomy of insects Nature undoubtedly presents the proper field for observation, experience demonstrates how few individuals (comparatively to the number of eggs), under ordinary natural surrounding conditions, attain the perfect or even chrysalis state; for it must be borne in mind that to an all-wise end Nature destroys just so many as die, directly or indirectly, from atmospheric causes, such as cold, heat, wet, drought, wind, &c., as well as from the attacks of natural enemies and the rest; so that the natural state then, even if it were *applicable, would* be disadvantageous for the purposes of the larva-*rearer.*

Of the semi-artificial plans, that which comes nearest to the natural state of things is, perhaps, the adoption of a green-house, or other apartment, in which our cares feed openly on growing plants; and thus, if sashes and doors be kept well closed, many enemies, such as birds, mice, wasps, and large Ichneumons, are kept at bay, though centipedes, woodlice, spiders, Acari, earwigs, Tineæ, ants, small Ichneumons, parasitic Diptera, and other plagues, still gain admittance; besides—the chances of wandering larvæ meeting with death by starvation, mutilation, or suffocation are, to say the least, very considerable, the temperature must, in many cases, be objectionable: and, owing to want of accuracy, this plan must be all but useless for descriptive purposes. For such larvæ, however, as are large and stick closely to their food, it affords the most agreeable and convenient means for observation, short of the natural state itself.

Another attempt to follow Nature is to confine the larvæ, together with a bunch or branch of the growing food, within a sleeve of gauze or leno; but, however perfect in theory the plan may appear, in practice the ill effects of a shower of rain or storm of wind are very painfully perceptible, in addition to which nothing—absolutely nothing is gained facility of observation is all but lost, the trouble of feeding is not overcome, and security is not attained, for the cage so formed is pretty sure to be rent by inevitable rotting and decay, torn by the wind or by the collector in the changing process, gnawed by mice, earwigs, or even by the enclosed larvæ themselves, to say nothing of the whole concern being carried off bodily by inquisitive or acquisitive biped.

Cages, or prisons which, while they more or less restrict the liberty of the occupants within, also serve to protect them from the attacks of enemies without, &c., are the more confessedly artificial appliances which come under our consideration; of these I here enumerate a few of the more prominent, glancing at the principles involved in their construction.

The old-fashioned safe-like breeding cage, is composed of a wooden frame work, and has the top, sides, and doors covered with either muslin (canvas), wire-gauze, glass, perforated zinc, or a combination of two or more of these, at the option of the proprietor. This cage is certainly susceptible of much improvement and modification, and may be useful enough in its way; but the difficulty of manipulation, added to a want of cleanliness, which, however expert and attentive the breeder may be, can hardly fail to exist, are the chief drawbacks.

Hat, toy and other boxes, the lids being covered with gauze, form *useful and handy* cages, when better are not obtainable; into these the

food-plant, plugged into a phial of water, or stuck into a juicy potato, may be inserted, and the larvæ placed thereon; in the case of flat shallow boxes, however, it is evident that the food, in its water vessel, would not stand upright; this difficulty is at once overcome by attaching a loop to one end at the back of the box, and by this hanging it to a nail on the wall.

An air-tight process of feeding is a favourite plan of rearing with many, by which the food is kept fresh for a considerable length of time. It is usually effected by grinding the lip of a jam-pot so that it may be accurately fitted with a piece of smooth glass, and into this receptacle the food and larvæ are placed; but the close unhealthy atmosphere, which, in spite of every caution and attention, must in greater or less degree be engendered, seems to me to render it unfit for general purposes, although I can strongly recommend it (as well as air-tight feeding in a closely stopped bottle) for accommodating very young larvæ, until they have attained sufficient size to be removed to a more appropriate cage: with this *proviso*, however, that both cage and food be dry, otherwise many of the young larvæ will be 'found drowned' in the moisture which is apt to condense on the sides of the too readily heat-conducting material of this cage: great care, also, should be taken that the temperature be not raised by the heat of the hand, or by the admission of sun-rays.

Lamp-chimneys, cucumber-glasses, &c., fitted at their open extremities with bungs, are sometimes employed, as also are tin boxes. These latter, however, have the further disadvantage of being opaque, and so preventing observation. The chief use of air-tight feeding comes into play when the larvæ of *Micro-Lepidoptera* are the subjects of attention.

Another contrivance carried out by suspending the food, the cut-off ends of which have been securely plugged into a phial of water, within a wide-mouthed bottle or jar; the chief drawback is that any hapless larva which chanced to drop would find itself much in the position of Daniel—barring the lions.

A flower-pot, with the hole at the bottom stopped, and the top covered with gauze or leno, kept in place by a piece of "elastic," offers an exceedingly cheap and simple cage, which, though laying no claims to perfection, the breeder will do well to think of in the hour of need.

A glass cylinder, the upper end being fastened over with muslin, the lower resting on a pan of damp sand, which latter, in the case of juvenile larvæ, is covered with thick writing-paper, is a method which has long been used by my friend, Mr. Doubleday. The cylinder being lifted off, the cut ends of the plant are stuck into the damp sand (through perforations in the paper when the latter is used), and the larvæ having been put on their food, the cylinder is replaced, thus, in a simple manner,

producing a cage which offers the advantages of admitting light and air, security, free observation, and not only keeps the food fresh, but readily allows of the operation of "changing" when necessary. If it be desirable to economize, a flower-pot filled with mould (into which the cut food, or, better still, the growing plant should be inserted) may be substituted for the pan of sand; and as for the cylinders, old lamp shades, broken tumblers, and other make-shifts may be used, though the neatest, cheapest, and most transparent cylinders are certainly the cut-off bottoms of glass shades, which can be procured from the warehouses, at prices varying from a penny upwards, according to size.

With a view of getting rid of the damp sand, which seemed to be objectionable, I some time since suggested the use of an unglazed earthenware plate, perforated at the centre for the food-plant to pass through into a jam pot containing water, beneath; the gauze-topped cylinder above resting on the rim of the plate, but it was soon found that the porcelain was too good a conductor of heat to suit the prolegs of such larvæ as might pass a night upon its surface; a piece of muslin was therefore strained from the centre perforation, where it was fixed, by means of a sail-eyelet (nautically termed a "thimble"), to over the circumference wherein it was pasted firmly down, and thus a non-conducting floor of muslin was formed, which permitted the passage of air *underneath* the cylinder, thereby giving a considerable amount of ventilation without draught.

A still further improvement has been achieved by my friend, Mr. Horn; it consists in making the floor of the cage slope downwards from the centre to the circumference, so that frass, &c., are thrown from the centre, and larvæ which may have left their food have to crawl up-hill to regain it. It is carried out as follows:—

(1.) Take a piece of book-muslin, and from its centre-part cut out a circular aperture of the diameter of the small end (bottom) of a jam pot; force the latter nearly through the aperture, and then tie the muslin firmly (underneath) to the groove which is under the lip of the jam-pot.

(2.) Fix the bottom of the jam pot, by means of elastic glue, to the centre of an inverted lid (wooden) of a round box, and strain over and fasten the muslin before mentioned to the hoop of the lid.

(3.) Insert a moveable water vessel in the jam pot above alluded to, and fit the latter with a bung which is to be perforated for the purpose of allowing the ends of the food to pass through into the water vessel below.

(4.) Place the gauze-topped cylinder on the muslin stage and the *cage is complete.*

By means of a little decorative ingenuity, a really handsome ornament may be made of this breeding-cage, and that, too, at an incredibly small outlay.

Having disposed of the cages suitable for ordinary feeding purposes, it will be well to say a few words on those contrivances which are appropriate for larvæ when about to prepare themselves for assuming the pupa state.

For those which go to earth, the old safe-like cage may be fitted with a trough of zinc or tin for holding the soil; or a flower-pot may be used, its porous composition being far preferable to the metals above named, the presence of which is decidedly objectionable. But if neatness be desired, a modification of the cylinder cage (either with or without the muslin stage), will be found both useful and ornamental.—When the muslin stage is used, instead of being tied to the groove of the jam pot, the borders of the central aperture are stitched on a ring of wire, having a diameter of, say, two inches more than the jam pot, and supported by radiating wires, secured from the groove of the jam pot to the wire ring. A propagating seed-pan, or other suitable vessel, must, of course, be substituted for the inverted lid. Larvæ find their way to the soil readily enough through the interstice which is left between the ring and the jam pot.

Soils, &c., for larvæ to enter.—Considerable diversity of opinion, respecting the substances, mixtures, &c., best adapted for this purpose, exists among Entomologists—probably at one time one is preferable, at another another; that which is most suitable for one species may be objectionable in the case of others. In selecting our soil we should be guided by the habits of the species for whose benefit we are cogitating, the nature of the soil which it inhabits, and the position, wet, dry, hot, or cold, which it selects for its transformation. For the rest I must leave the choice to the reader, merely contenting myself with an enumeration of the most approved kinds: loam, leaf-mould, pine forest mould, silver sand, sand, or "ballast," the latter is, however apt to "cake"—the rubbish from the roots of oaks and forest trees, rotten wood, bran, cocoa-nut fibre—birch catkins (rubbed between the hands into light flakes), or combinations of from two to half-a-dozen of them. All soils should be first well baked to destroy animal life (such as acari, slugs, eggs or larvæ of *Tineæ*, spiders, worms, &c.), they should then be tied up in canvas bags, damped, and kept in a moist but ventilated situation until required for use. Where it is required to keep up a certain degree of moisture, the soil should be covered with a layer of *cocoa-nut fibre*, a capital means of preventing the soil beneath from *drying too dry*, or moss first prepared by a few dips into boiling water.

The breeding-house, or apartment to be used for the purpose, should, of course, be constructed, or chosen, with a view to the health of the occupants, and the following conditions should be taken into consideration. *Aspect.*—One side facing the east, at any rate, should be provided with a window, in order that the rays of the early morning sun may gain admittance: this, with many larvæ, is a condition of paramount importance. *Ventilation.*—This should be complete, but so managed that thorough draught be avoided, at the same time that the apertures by which it is effected are sufficiently small to prevent the ingress of "natural enemies" to our nurselings; for bringing this about, the free employment of finely perforated zinc in the construction of the breeding-house is of the utmost utility. *Temperature.*—This ought never to be too high, a roofing of Portland cement (flat tiles being embedded in it for the purpose of "tying" it together), being nearly white when dry, affords the greatest protection against the vertical rays of the sun, but, in addition, when the weather is excessively hot, watering the floor and ground adjacent to the breeding-house may be employed with advantage. *Space.*—As much room as possible should be allowed; the more the better. *Light.*—It is rather a disputed point whether a large or small amount of light is advantageous in a general way: my own impression is that some larvæ thrive best with plenty of light, others in comparative darkness; and I think it might be taken as a criterion that if the perfect insects are day-flyers (such as butterflies, for example), their respective larvæ will be found to thrive best with a more or less abundant supply of light; while if they shun light (as the majority of the *Noctuæ*), their larvæ will probably get on better in a darkened situation, &c.; the apartment should therefore be constructed with a view to this, and the cages arranged accordingly.

Food.—Doubtless the rearer of *Lepidoptera* must often be perplexed as to what (in the event of the proper food being unobtainable) he shall provide for the sustenance of his larvæ. With a view to setting him on the tack most likely to yield success, the following few suggestions and lists will, it is to be hoped, at any rate serve to arrange his ideas upon the point.

As a matter of course, when the true food-plant is at hand, it should be used in preference to all others; should it not naturally occur in our neighbourhood it may, previously to its requirement, be potted or transferred to our garden-beds in readiness for future use; or it may be regularly transmitted at suitable intervals, secured in tins, when the locality *in which it* occurs is too far off to admit of our taking a series

of journeys after fresh supplies of it. On the other hand, if the known food be not obtainable a substitute must be found.

Substitute food-plants may be divided into at least four classes, viz.:—Allied species (cultivated forms, &c.) of plants; allied genera (families may here be included); known substitutes (non-allied); general favourite foods.

Allied species to the true food-plant will usually offer the best chances of success. By way of a few examples of this class of substitutes let me mention the following:—for aspen, poplar may be tried; for bedstraw, clivers; for bilberry, cranberry or cowberry; for bramble, raspberry; for campion, ragged robin; for Canterbury-bell, hare-bell; for sallow, willow; for sloe, plum or greengage; for primrose, polyanthus; for rock-rose, gum-cistus; for sweet briar, rose; for vetchling, everlasting pea; for violet, heartsease; for weld, mignonette; for willow herb, rose-bay; for wormwood or mugwort, southernwood: besides many others, especially cultivated forms for wild ones, which might be enumerated.

Allied genera present a second choice of food-plant: subjoined is a list of some examples (classed under the headings of the orders or sub-orders to which they belong), for the guidance of those whose acquaintance with botanical lore is, as in my own case, scanty.

SOME EXAMPLES OF ALLIED GENERA OF PLANTS.

RANUNCULACEÆ: *Actæa*, Baneberry.—*Aconitum*, Monkshood.—*Adonis*, Pheasant's-eye.—*Anemone*, Anemone.—*Aquilegia*, Columbine.—*Caltha*, Marsh marigold.—*Clematis*, Traveller's joy.—*Delphinium*, Larkspur.—*Helleborus*, Hellebore.—*Myosurus*, Mouse-tail.—*Nigella*, Devil in the bush.—*Pæonia*, Pœony.—*Ranunculus*, Crow-foot.—*Thalictrum*, Meadow rue.—*Trollius*, Globe flower.

PAPAVERACEÆ: *Chelidonium*, Celandine.—*Glaucium*, Horned poppy.—*Mecanopsis*, Welsh poppy.—*Papaver*, Poppy.

ARABIDEÆ (CRUCIFERÆ): *Arabis*, Rock cress.—*Barbarea*, Winter cress.—*Cardamine*, Bitter cress.—*Cheiranthus*, Wall flower.—*Matthiola*, Stock.—*Nasturtium*, Water cress.—*Turritis*, Tower mustard.

BRASSICEÆ AND SISYMBREÆ (CRUCIFERÆ): *Brassica*, Cabbage, Turnip.—*Erysimum*, Treacle mustard.—*Hesperis*, Dame's violet.—*Sinapis*, Mustard.—*Sisymbrium*, Hedge mustard.

ALYSSINEÆ (CRUCIFERÆ): *Alyssum*, Alyssum.—*Armoracea*, Horse-radish.—*Cochlearia*, Scurvy grass.—*Draba*, Whitlow grass.

LEPIDIEÆ AND THLASPEÆ (CRUCIFERÆ): *Capsella*, Shepherd's purse.—*Iberis*, *Candy tuft*.—*Lepidium*, Cress.—Thlaspi, Pennycress.

SILENEÆ (CARYOPHYLLEÆ): *Agrostemma*, Corn cookle.—*Dianthus*, Pink.—*Lychnis*, Campion.—*Saponaria*, Soap wort.—*Silene*, Catchfly.

ALSINEÆ (CARYOPHYLLEÆ): *Alsine*, Chickweed.—*Arenaria*, Sand wort.—*Cerastium*, Mouse-ear.—*Cherleria*, Cyphel.—*Polycarpon*, All-seed.—*Sagina*, Pearl wort.—*Spergula*, Spurrey.—*Stellaria*, Stitch wort.

MALVACEÆ: *Althœa*, Marsh Mallow.—*Lavatera*, Tree Mallow.—*Malva*, Mallow.—*Alcea*, Hollyoak.—*Hibiscus*, Hibiscus.

GERANIACEÆ: *Erodium*, Stork's-bill.—*Geranium*, Crane's-bill.—*Pelargonium*, Greenhouse geranium.

VICIEÆ (PAPILIONACEÆ): *Lathyrus*, Everlasting pea.—*Orobus*, Bitter vetch.—*Pisum*, Pea.—*Vicia*, Vetch.

LOTEÆ (PAPILIONACEÆ): *Anthyllis*, Kidney vetch.—*Astragalus*, Milk vetch.—*Cytisus*, Broom.—*Genista*, Greenweed.—*Lotus*, Bird's-foot trefoil.—*Medicago*, Medick.—*Melilotus*, Melilot.—*Ononis*, Rest harrow.—*Trifolium*, Trefoil.—*Trigonella*, Fennygreek.—*Ulex*, furze.

HEDYSAREÆ (PAPILIONACEÆ): *Astrolobium*, Joint vetch.—*Hippocrepis*, Horse-shoe vetch.—*Onobrychis*, Sainfoin.—*Ornithopus*, Bird's-foot.

AMYGDALEÆ (ROSACEÆ): *Amygdalus*, Almond, Peach.—*Cerasus*, Cherry, Laurel.—*Prunus*, Plum, Sloe.

POMACEÆ (ROSACEÆ): *Co'oneaster*, Cotoneaster.—*Cratœgus*, Hawthorn.—*Mespilus*, Medlar.—*Pyrus*, Crab, Service, Pear.

DRYADEÆ (ROSACEÆ): *Agrimonia*, Agrimony.—*Comarum*, Marsh cinquefoil.—*Dryas*, Mountain avens.—*Fragaria*, Strawberry.—*Geum*, avens.—*Potentilla*, Cinquefoil.—*Rubus*, Bramble, Raspberry.

SANGUISORBEÆ (ROSACEÆ): *Alchemilla*, Lady's mantle.—*Poterium*, Salad burnet.—*Sanguisorba*, Burnet.

ONAGRACIÆ: *Circœa*, Enchanter's nightshade.—*Epilobium*, Willow herb.—*Fuchsia*, Fuchsia.—*Isnardia*, Isnardia.—*Œnothera*, Evening primrose.

UMBELLIFERÆ: *Ægopodium*, Gout weed.—*Æthusa*, Fool's parsley.—*Angelica*, Angelica.—*Anthriscus*, Beaked parsley.—*Bunium*, Earth nut.—*Carum*, Caraway.—*Chœrophyllum*, Chervil.—*Cicuta*, Cowbane.—*Conium*, Hemlock.—*Daucus*, Carrot.—*Fœniculum*, Fennel.—*Heracleum*, Cow parsley.—*Ligusticum*, Lovage.—*Peucedaneum*, Hog's fennel.—*Petroselium*, Parsley.—*Pimpinella*, Burnet-saxifrage, *Sium* Skirret.

CAPRIFOLIACEÆ: *Linnæa*, Linnæa.—*Lonicera*, Honeysuckle.—*Sambucus*, Elder.—*Viburnum*, Guelder rose.—*Symphoricarpus*, Snowberry.

STELLATÆ: *Asperula*, Woodruff.—*Galium*, Bedstraw.—*Rubia*, Madder.—*Sherardia*, Field madder.

DIPSACEÆ: *Dipsacus*, Teasel.—*Knautia*, Knautia.—*Scabiosa*, Scabious.

CORYMBIFERÆ (COMPOSITÆ): *Achillea*, Yarrow.—*Anthemis*, Chamomile.—*Artemisia*, Wormwood.—*Aster*, Star wort.—*Bellis*, Daisy.—*Cineraria*, Flea wort.—*Chrysanthemum*, Ox-eye.—*Eupatorium*, Hemp agrimony.—*Gnaphalium*, Cudweed.—*Helianthus*, Sunflower, Jerusalem artichoke.—*Inula*, Elecampane.—Petasitis, Butter burr.—Pulicaria, Flea bane.—*Senecio*, Groundsel, Ragwort.—Solidago, Golden rod.—*Tanacetum*, Tansy.—*Tussilago*, Colt's-foot.

CYNAROCEPHALEÆ (COMPOSITÆ): *Carduus*, Thistle.—*Centaurea*, Knapweed.—*Cynara*, Artichoke.—*Lappa*, Burdock.—*Onopordon*, Cotton thistle.—*Serratula*, Saw wort.—*Silybum*, Milk thistle.—*Xanthium*, Bur weed.

CICHORACEÆ (COMPOSITÆ): *Apargia*, Hawkbit.—*Arnoseris*, Swine's succory.—*Cichorium*, Succory.—*Crepis*, Hawk's-beard.—*Helminthia*, Ox-tongue.—*Hieracium*, Hawkweed.—*Hypochœris*, Cat's-ear.—*Lactuca*, Lettuce.—*Taraxicum*, Dandelion.—*Picris*, Picris.—*Sonchus*, Sow thistle.—*Scorzonera*, Scorzonera.—*Tragopogon*, Goat's-beard.

CAMPANULACEÆ: *Campanula*, Bell flower.—*Jasione*, Sheep's bit.—*Phyteuma*, Rampion.—*Prismatocarpus*, Corn bellflower.

ERICACEÆ: *Arbutus*, Strawberry tree.—*Arctostaphilus*, Bearberry.—*Azalea*, Azalea.—*Calluna*, Ling.—*Erica*, Heath.—*Menziesia*, Menziesia.—*Rhododendron*, Rhododendron.

OLEACEÆ: *Fraxinus*, Ash.—*Ligustrum*, Privet.—*Syringa*, Lilac.

GENTIANEÆ: *Cicendia*, Cicendia.—*Chlora*, Yellow wort.—*Erythræa*, Centaury.—*Gentiana*, Gentian.—*Menyanthes*, Buckbean.—*Villarsia*, Villarsia.

BORAGINEÆ: *Anchusa*, Alkanet.—*Asperugo*, Madwort.—*Borago*, Borage.—*Cynoglossum*, Hound's-tongue.—*Echium*, Viper's bugloss.—*Lithospermum*, Gromwell.—*Lycopsis*, Bugloss.—*Myosotis*, Scorpion grass.—*Pulmonaria*, Lung wort.—*Symphytum*, Comfrey.

ATROPEÆ (SOLONACEÆ): *Atropa*, Belladonna.—*Datura*, Thorn apple.—*Hyoscyamus*, Henbane.

SOLANEÆ (SOLANACEÆ): *Solanum*, Bitter-sweet, Nightshade, Potato.—*Lycium*, "Tea" tree.

RHINANTHIDÆ (SCROPHULARIACEÆ): *Bartsia*, Bartsia.—*Euphrasia*, Eye bright.—*Melampyrum*, Cow wheat.—*Pedicularis*, Louse wort.—*Rhinanthus*, Yellow rattle.—*Veronica*, Speedwell.

ANTIRRHINIDÆ (SCROPHULARIACEÆ): *Antirrhinum*, Snapdragon.—*Digitalis*, Foxglove.—*Linaria*, Toad flax.—*Mimulus*, Monkey flower.—*Scrophularia*, Water betony.—*Verbascum*, Mullein.

LABIATÆ: *Ajuga*, bugle.—*Ballota*, Horehound.—*Calamintha*, Calamint.—*Clinopodium*, Wild basil.—*Galeopsis*, Hemp nettle.—*Glechoma*, Ground ivy.—*Lamium*, dead nettle.—*Mellitis*, Bastard balm.—*Mentha*, Mint.—*Nepeta*, Cat mint.—*Origanum*, Marjoram.—*Prunella*, Self heal.—*Salvia*, Sage.—*Scutellaria*, Skull cap.—*Stachys*, Wound wort.—*Teucrium*, Germander.—*Thymus*, Thyme.

PRIMULACEÆ: *Anagallis*, Pimpernel.—*Centunculus*, Chaffweed.—*Cyclamen*, Cyclamen.—*Glaux*, Sea milkwort.—*Hottonia*, Feather foil.—*Lysimachia*, Loose strife.—*Primula*, Primrose.—*Samolus*, Brook weed.—*Trientalis*, Chickweed winter-green.

CHENOPODIACEÆ: *Atriplex*, Orache.—*Beta*, Beet.—*Chenopodium*, Goosefoot.—*Salicornia*, Glass wort.—*Salsola*, Salt wort.—*Spinacia*, Spinach.

POLYGONEÆ: *Oxyria*, Mountain sorrel.—*Polygonum*, Knot-grass, Persicaria.—*Rumex*, Sorrel, Dock.—*Rheum*, Rhubarb.

EUPHORBIACEÆ: Buxus, Box.—*Euphorbia*, Spurge.—*Mercurialis*, Mercury.

URTICACEÆ: Cannabis, Hemp.—Humulus, Hop.—Parietaria, Wall pellitory.—*Urtica*, Nettle.

BETULINEÆ: *Alnus*, Alder.—*Betula*, Birch.

CUPULIFERÆ: *Carpinus*, Hornbeam.—*Castanea*, Chestnut.—*Corylus*, Hazel.—*Fagus*, Beech.—*Quercus*, Oak.

SALICINEÆ: *Populus*, Poplar and Aspen.—*Salix*, Osier, Sallow, Willow.

CONIFERÆ: *Juniperus*, Juniper.—*Pinus*, Fir.—*Taxus*, Yew.

"**A known substitute,**" by which is meant a plant known, in the case of some other larva, to afford nourishment in the absence of its more accustomed food, is a third resource; thus, by way of giving an example or two, bilberry is the food of *Gastropacha ilicifolia*, but it will also eat sallow; *ergo*, it would seem reasonable to suppose that another species, the food of which is bilberry, would also eat sallow, and this in practice we find (very often, at all events) to be the case. And again, it is a curious fact, that all species which feed naturally on the *Cruciferæ* will also eat *Tropæoleum*, as well as *Reseda*,—plants nowise allied to them or to one another. A reference to the following table, which I have endeavoured to condense as much as possible, will, I trust, sometimes assist the reader in selecting a substitute food-plant.

A FEW EXAMPLES OF KNOWN SUBSTITUTES (NON-ALLIED PLANTS).

SUBSTITUTES.		EXAMPLES.
Apple	and Ash	*Z. æsculi*
,,	,, Lime	*X. petrificata*
,,	,, Poplar	*S. ocellatus*
Bedstraw	,, Convolvulus	*A. emarginata*
,,	,, Epilobium	*C. elpenor*
,,	,, Fuchsia	*D. galli*
,,	,, Vine	*D. livornica*
Bilberry	,, Bramble	*H. rectilinea*
,,	,, Dogwood	*E. advenaria*
,,	,, Rose	*E. advenaria*
Birch	,, Beech	*T. consonaria*
,,	,, Hazel	*G. papilionaria*
,,	,, Spindle	*B. repandata*
,,	,, Whortleberry	*B. abietaria*
Bramble	,, Hazel	*Psy. calvella*
,,	,, Heath	*S. carpini*
Broom	,, Brake-fern	*H. pisi*
,,	,, Honeysuckle	*H. thalassina*
,,	,, Lilac	*T. gothica*
,,	,, Vetch	*D. obfuscata*
,,	,, Veronica	*H. pisi*
Currant	,, Hop	*Eup. assimilata*
Honeysuckle	,, Groundsel	*P. iota*
,,	,, Nettle	*P. iota*
,,	,, *Privet*	*P. syringaria*

SUBSTITUTES.		EXAMPLES.
Honeysuckle	and Rose	*A. derivata*
Heath	and Bog-myrtle	*A. menyanthidis*
,,	,, Hare-bell	*A. Ashworthii*
Ivy	,, Buckthorn	*L. Argiolus*
,,	,, Elder	*O. sambucaria*
,,	,, Holly	*L. Argiolus*
Lime	,, Elm	*S. tiliæ*
Oak	,, Ash	*S. illustraria*
,,	,, Elm	*S. lunaria*
,,	,, Lime	*P. monacha*
,,	,, Whitethorn	*H. thymiaria*
,,	,, Willow	*O gonostigma*
Sallow	,, Bilberry	*E. advenaria*
,,	,, Birch	*D. falcula*
,,	,, Heath	*E. cribrum*
,,	,, Marjoram	*L. marginata*
,,	,, Oak	*O. gonostigma*
,,	,, Plum	*S. illunaria*
,,	,, Primrose	*T. fimbria*
,,	,, Yarrow	*N. zonaria*
Stachys	,, Clematis	*A. strigillata*
Yarrow	,, Marjoram	*A. gilvaria*
,,	,, Pink	*A. incanata*
,,	,, Vetch	*A. incanata*
,,	,, Chamomile	*C. chamomilla*

"**Generally favourite foods**" come last, but by no means least; they afford us a very likely group to choose from, especially in the case of such larvæ as the true food remains undetected; indeed, for the rearing of previously undiscovered larvæ, particularly of the *Geometridæ* and *Noctuidæ*, this class of "substitute foods" is invaluable. It is perfectly wonderful to note how universally *Polygonum aviculare* is esteemed by the larvæ of *Geometridæ*. This fact was communicated to me some years since by my valued friend, Mr. Henry Doubleday, since which time I have invariably offered it to all such larvæ, concerning the food of which I had any doubt, and in almost all cases it was at once adopted; it undoubtedly holds the first place, followed by *Lotus*, *Glechoma*, &c., among low plants, with sallow and blackthorn among shrubs: for *Noctuæ* Plantain, Dandelion, Dock, Lettuce, Clover, Borage, and Goosefoot, will all be found very serviceable, and so also will Sallow, Birch, and Plum, in the case of such larvæ as may be suspected of feeding on taller vegetation, though it must be owned that the great bulk of "*larvæ unknown*" feed upon low herbs.

Feeding.—The kind of food having been determined upon, a few hints as to collecting it, &c., may be added. As a general rule food, like fruit, should be gathered early in the morning, and if conveyed any distance, packed very lightly. When, however, intended for juvenile larvæ which are being reared on the air-tight principle, it must not be picked until the morning sun has dispelled the dew from its surfaces; though for more advanced individuals, when fed in ventilated situations, this same dew, or the moisture caused by a shower or even by the water tap, gives an invigorating fillip to the appetite, which cannot be otherwise than healthful. It may be noted here, that when the food is too wet, the best and quickest plan to dry it is—having placed it in a towel, the four corners of which are held in one's hand, to *swing* it round and round, and thus get rid of the extra dampness by centrifugal force, whereby the plant is not bruised, as would be the case if shaking were resorted to, to dislodge the moisture: or it may be dried nicely in the draught caused by opening a window-sash two or three inches, and placing the food half-a-foot inside the window.

The more mature foliage is generally chosen by the larvæ, but by no means invariably so, since many appear to prefer the young tender shoots, and of course, in some cases, even unexpanded buds.

Nearly all larvæ like their food healthy and fresh: but the risk of their being injured in changing it, often makes it advisable to be content *with clipping the ends* of the twigs, &c., which go into the water; and *indeed this practice will* keep the food fresh for a long time. There are,

however, some special and curious exceptions to the rule that fresh healthy food is preferred, for, while the larva of *Aleucis pictaria* selects the stunted unhealthy-looking sloe-bushes, *Cidaria* (*?*) *sagittata* and *Pterophorus hieracii* actually cause their food to wither before partaking of it; and in the case of *Petasia nubeculosa* careful feeding with fresh food seems to fail, though a stale dryish diet affords a far greater likelihood of success.

Before the requisite food is in leaf, or even in bud, it sometimes happens, even in Nature, that eggs hatch, and hybernating larvæ come forth, in which case unopened buds, if to be found, may be split and offered with considerable chances of success; they must, however, be frequently renewed, and not allowed to dry up. By this means with care, and luck on our side, we may manage to keep our larvæ going while we look out for a stray example of a food-plant, in some sheltered nook or other, perchance more forward than the rest of its species, or till buds have in due time expanded into little leaves: but if not even buds are attainable, then our only alternatives lie between supplying peeled or rasped twigs and bark, finding a "substitute," or leaving our *protégés* entirely to their fate.

An alterative diet, in the cases of certain larvæ, not altogether polyphagous, seems important—even necessary: thus it has been recommended to feed *Dipthera Orion* on oak and birch, *Noctua neglecta*, and perhaps, too, *Agrotis agathina*, should be provided with heath, sallow, &c., and *Cerastis vaccinii* has been found to thrive best on oak and dock.

The larva of a species feeding naturally on one plant may, in the next generation, refuse its natural food and adopt another, thus—one season *Tephrosia consonaria* would not touch beech, but fed up readily enough on birch, and *Ennomos erosaria* reared upon oak, would eat nothing but birch in the next batch.

It is sometimes considered desirable, and occasionally even absolutely necessary, to supply captured larvæ with food procured, if not off the same tree or shrub, at least from the same locality as that in which they previously fed.

The larvæ of coast species are at times exceedingly hard to rear when the attempt is made to feed them up in inland situations—in such cases it is frequently imperative to procure food from the sea-side; but there is another ingenious alternative, namely, to damp the food with sea-water, of which a supply must be kept on hand for the purpose, as, for example, in breeding *Mamestra abjecta*, &c., though sometimes even a substitute food, when sprinkled with sea brine, will answer instead of the native food, as in the instance of Bombyx castrensis, which will thrive on pickled wild cherry.

All food should be rigidly searched over for cannibals and other vermin before admitting it to our breeding-cages.

Lichens and mosses, when they have to be employed as food, should be collected damp, and with the substance to which they are attached adherent if possible, and they should be renewed whenever they cease to look fresh; but the old food should not be hastily cast away; it should be put by, under cover, and carefully watched from time to time for any larvæ which may turn up, especially if at the time of changing any were missing; and this reminds me that it is well to know the number of individuals in a brood, for one can then be certain whether they have or have not *all* been shifted. And it may also be laid down as a general rule that there is much greater chance of a successful result in the way of imagos when we are content with a moderate number of larvæ, than when we collect, or retain for ourselves after egg-hunting, a large crowd of the larvæ of any species.

The management of internal stem or root-feeders, seed-feeders, &c., has already been referred to, see page 15.

Wood-feeders may be kept in flower-pots or wide-mouthed bottles, with wire-gauze covers, or in tins (for nothing in strength short of *tin* or earthenware and wire-gauze will defy the jaws of *Cossus*), being allowed either to remain in the logs, branches, or twigs in which they were originally feeding when removed, or else supplied with the fresh cut (but not wet) sawdust and chips of their food. The tins should be freely perforated, and a sharp eye should be kept for mildew, which, when present, should be removed, and fresh food supplied. These remarks similarly apply to bark feeders.

Larvæ feeding on vegetable refuse, dried fruit, honeycomb, feathers, hair, dung, &c., may be kept supplied with their food in suitable boxes; no particular precaution being necessary beyond securing the prisoners from escape, and the prevention of mould.

Manipulation.—The diversified habits of larvæ, from their exclusion out of the egg forwards, frequently perplex the breeder as to the best means of managing them. To begin with the juveniles: some of them will not take kindly to their food; and this often happens if a substitute have been forced upon them in lieu of their legitimate diet; they become restless, crawl wildly about, flock to the lightest part of the cage, squeeze themselves through ridiculously small apertures, entangle and suspend themselves hopelessly in festoons, and in fact do anything rather than settle down rationally to their breakfasts. Such individuals should be reared, until more accustomed to their new mode of life, in

air-tight jam-pots, the tops of which are covered over with green glass, for the purpose of darkening the interior of the vessel; a condition of things usually promotive of quietude among the brood—quietude giving time for reflection, and rise to second thoughts (proverbially best) that the cravings of nature should be satisfied even though the fare set before them be not precisely to their palate, and the apartment suggestive of the converse of their ideas of liberty; moreover, at this, and indeed every stage, they should not be overcrowded.

Then, again, others drop by silken threads on the approach of real or imaginary danger; a wise provision, as I believe, for their preservation against birds and also cannibals, which, of course, could not well follow them down the thread. These, too, are most easily and best fed in air-tight cages; but in their case the green glass cover may be dispensed with.

It is the peculiarity (evidently in some way connected with the well-being of the creatures) of certain larvæ to make their first meal off the egg-shells, or part of them, from which they have recently emerged; others, for some inscrutable reason, shedding and devouring their first skin (and, in the case of *Dicranura vinula*, every skin they cast), before betaking themselves to their more orthodox mode of living. These should be left alone to crawl to their food; indeed, it should be put down as a rule that stationary larvæ (especially little ones) should never be meddled with; while crawling larvæ are generally in want of some attention.

Nor must it be forgotten that many small larvæ (and big, too, for that matter) render themselves invisible by mining, entering buds, and spinning together leaves; or elude our vigilence by closely fixing and assimilating themselves to the twigs, stalks, mid-ribs, and edges of the leaves of their food. With such experts to deal with, great circumspection is necessary in the changing process, not only that none of our cares may escape observation, but also that no clumsy handling may bring grief or even demolition to the tender objects of our solicitude. When larvæ are known to have this sort of propensity, it is best to supply them with as small a quantity of fresh food as is consistent with their requirements, and in changing the same to let all parts remain which are in the least degree suspected of, or capable of, containing occupants.

N.B.—Of course, when pellets of excrement, even though in the case of certain neophytes microscopic, are observable, it may be taken for granted that (always excepting the presence of interlopers introduced with the food) our "cares" are availing themselves of their diet.

Having thus touched upon some of the habits of little larvæ which

act as obstacles with which the larva-rearer has to contend, let us see in what manner other habits may be turned to account in assisting us in the changing process. Firstly, sometimes a very slight jar or even a puff of breath will dislodge pretty nearly every tenant of the bunch of food,—in which case we can quickly transfer them to the jam-pot, or the cylinder turned topside (muslin end) downwards: in the latter case they will not be long in attaching themselves to the muslin. Secondly, a more or less sharp jar will cause certain of them to lower themselves by threads, by which they may be readily shifted on to the fresh food. Thirdly, a slight touch with a camel's-hair pencil causes others to fall perpendicularly downwards; while a fourth batch exhibits a very keen sense of the proximity of newly-gathered food, and may be left to find their own way from the stale to the fresh supply, and so on.

In conducting the changing process I would impress upon the reader the advisability of first preparing a duplicate cage (whether jam-pot, flower-pot, or cylinder), by "sweetening" it with free currents of dry fresh air, and then stocking it with a proper quantity of appropriate food. In the second place the contents of the cage to be operated on, live-stock and all, should be turned out on a large white meat-dish, an utensil possessing prodigious advantages over the more-often-used sheet of paper, both in point of cleanly whiteness of material and also in smoothness of surface, such as would puzzle even an "lubricipede" to escape from; while a similar attempt on the part of a geometer would be simply preposterous; indeed, the position of most larvæ on the glazed superficies is much that of an incipient skater down on the ice, and gladly as a rule do they avail themselves of the proffered twig: easily, too, may such as spin threads be lifted by their silken appendices with the aid of a camel's-hair brush, and transferred to the newly-prepared quarters; while those that sham death can be literally shovelled into their fresh domicile.

The old food having been jarred over the dish, and larvæ which fall transferred, should next be searched over for such as show no disposition to leave go their hold, and these latter may be detached by clipping off *carefully* (for if done with a "*snap*" the larvæ are jerked away) with a pair of scissors the portion of the food on which they rest, and allowing the larvæ with the pieces thus cut off to fall gently on the fresh supply of food; for I hold that, though several kinds of larvæ do not appear to sustain injury from tender handling, it is, as a rule, neither necessary nor desirable to touch them with the fingers. Painfully undesirable indeed is *it to handle the larva of Porthesia chrysorrhœa*, and other hairy larvæ in less degree, for should their easily detached spines become applied to any

tender part of our skin, an intolerable irritation is produced, which is very difficult to alleviate. Indeed, on the Continent, the hyperæsthetic symptoms produced by the larva of *Cnethocampa processionea* and *pityocampa* have been known to result even in death. The old food should not always be thrown away at once, but left on the glazed dish for future examination, in the event of there being amongst it any larvæ which may have eluded us.

Larvæ which in Nature hybernate must either be stimulated by warmth and fresh food to feed up unnaturally fast, or else through the winter must be exposed to out-door temperature.

Some hybernating larvæ are full fed before taking up their winter quarters, in which case they will of course feed no more. Others exhibit no desire for food until the spring. But not a few come forth during the warm days and evenings of winter and early spring to practise with their jaws. These latter, when reared in captivity, require some attention on the part of the breeder. Of a certainty however, as trees and shrubs, with the exception of evergreens, are bereft of foliage in winter, larvæ feeding ordinarily upon them must, if they have to eat at this season, content themselves with other pabulum in the shape of non-deciduous plants, of which arbutus, laurustinus, ivy, heath, and fir are the greatest favourites, or low-growing plants, such as forced seedlings of knotgrass (strongly recommended), chickweed and groundsel, plantain seeds, as well as grasses and mosses; though in the case of some low-feeding larvæ, especially geometers (*Acidaliæ*), they are quite satisfied with nibbling during the winter the withered leaves and stems of the plants on which they have been reared; but this does not prevent their keeping a very sharp look-out for the earliest buds that come in spring.

I may just note here that, as water in its metamorphosis to ice is apt to inconveniently expand our vessels, potatoes, turnips, and carrots are serviceable not only as supplying moisture in its place, but also as a provender, it being sometimes found that larvæ, on becoming aware of the presence of the tuber or roots, have availed themselves of them as food.

Hybernating hairy larvæ must during the winter be kept dry, or in a well-ventilated place, otherwise the damp seems to hang about their fur, and causes them to be attacked by a white fungus which creeps through their frame and speedily destroys them. Smooth larvæ, on the contrary, seem to require the natural dampness of the soil; most of the hybernating larvæ of the *Noctuæ* require hiding-places, seeming to quickly pine away if not freely supplied, for the purpose, with soil, dead leaves, &c. For those of *Orthosia, Xanthia, Noctua*, &c., pieces of bark, broken chip boxes, bits of flannel, &c., may be employed; while for Agrotis and a few others a considerable depth of sand or fine earth is necessary.

NOTE.—The late Mr. Gibson used strongly to recommend that during the winter all cages containing larvæ should be placed in front of a window facing the east or north east, so that the inmates might be kept as cool as possible. This he considered of vast importance; and his very great success in rearing hybernating larvæ, so generally looked upon as stumbling-blocks in the path of the breeder, added much force to his suggestion. As soon, however, as food could be procured, he supplied them with it, and simultaneously endeavoured to rouse them to activity with all the natural heat of sun-rays at his command.

A word or two is necessary concerning the treatment of cannibal and viciously-disposed larvæ. Some, such as *Cosmia trapetzina*, have such depraved notions of gastronomy that they cannot always be trusted even with their own brothers and sisters.—these must, of course, be fed separately. Others, which devour larvæ with avidity, feed up harmoniously enough *inter se*, such are the blood-thirsty *Scopelosoma satellitia*, *Tæniocampa miniosa*, and *Crocallis elinguaria*; they must not be stinted in their food, though, for the cravings of a hungry stomach would probably render them conveniently oblivious of the ties of relationship. I suppose, too, they should be supplied with living animal food occasionally; but it seems a horrible thing to recommend, and it is doubtful whether it is absolutely necessary. Again, certain larvæ, though not actually carnivorously disposed, but at the same time not naturally meant to live gregariously, act in a quarrelsome, snappish, and vicious manner to other larvæ crossing their path or interfering in any way with their comfort, often by their bite causing the victim to dwindle and eventually die: these individuals also should be placed in solitary confinement: others not naturally cannibalistic (at least I suppose not), would appear to assume the habit in captivity, as the account of that of *Thecla quercûs* coolly demolishing the pupa of his more advanced brother seems to indicate. A weather eye must be kept open for such customers, and their propensities circumvented.

Then, again, nothing is more common with careless breeders than for the peaceable hawk-moths, "kittens," and other larvæ, when kept on short commons, to nibble off the caudal appendages of their relatives, an operation which I am by no means sure does not originate in their erroneously considering these excrescences to be of a vegetable character.

What a blessing to the slovenly would such larvæ as those of *Glottula pancratii* be! M. Millière thus quotes from a letter of his friend, M. Daube:—"They eat the leaves of the *Pancratium*, then the flowers, *the seeds (if not too forward)*, and the root, which they attack in the last *place; and when they* have demolished the bulb, which they void just as

if it had been ground up by their powerful mandibles, they eat their frass; and curious to tell, those which are nourished after this strange fashion, undergo their transformations quite as well, and produce imagos quite as fine, as the others!! It is the only larva which has this peculiarity." M. Daube is pretty nearly right in his latter supposition: *Gelechia cerealella* is the only we know of.

The furore to possess "varieties" (so called, for under variation, are now-a-days included aberrations, malformations, and even examples of hermaphroditism), which rages among British Macro-Lepidopterists, together with a growing interest by students in all branches of Natural History touching that vexed subject—the variation of species—has opened up a vast field for enquiry as to the influences which produce these interesting freaks of nature.

"**Variety-breeding,**" as it has been not inaptly termed, though yet in its infancy, would appear to offer the most practical means of arriving at something like a definite solution of the mystery, and as this art comes within the province of the larva rearer, I purpose glancing at those influences which are supposed to act on the preliminary stages of insect life to produce variation in the perfect state: to be brief then—

Influences acting ab initio. These may be accidental or hereditary—with the former we have little to do, but they may account for the formation of certain monstrosities in which organs are multiplied, suppressed, or modified through error in the primary impulse. Hereditary influences, on the other hand, will account for a large proportion of varieties, and may without doubt be turned to account as well by the variety breeder of insects as the Herefordshire farmer or the pigeon fancier, by the careful selection of parent stock with a view to peculiarities, whether structural or ornamental, being reproduced in the progeny. Of this we have (*e.g.*) instances in the rearing of negro varieties from parents more or less tainted with melanism; and of imperfections perpetuated, as in the frequent recurrence of individuals wanting a hind-wing, which may be noticed even at large in *Macaria notata*. That these are the results of hereditary influences would seem to be demonstrated by the fact that, while certain species have a tendency to vary in the above and other manners, few species are liable to the same extent of variation, and many apparently to little or even none at all.

Of course it must be understood that these hereditary peculiarities have originally been acquired through some accident, or by the force of surrounding conditions, and have in the course of generations become perpetuated in what is termed a variable species, or in a race of individuals *presenting* appreciable differences from the typical form.

Topographical influences we have now to deal with, these act in greater or less degree on the fauna of a district through the nature of the locality; and among them the soil especially would appear to exert a potency, since we find certain species varying according as they may have reproduced, generation after generation, on a chalky, peaty, gravelly, or other soil. This cause probably acts indirectly through the vegetation of the respective districts which doubtless undergoes some modification. Somebody speaks of a chemical variety, too, and gives the case of *Ellopia fasciaria* and *prasinaria* as an example.

Food we have next, and whatever influence this may exert must naturally be upon the larva; but of the fact that it does operate in various ways to modify the future imago we have ample proof. The colour of the perfect *Tortrix viridana* is a familiar example of the power of food to produce variation in the imago, and there are many other instances of so-called phytophagic species, races, or varieties, chiefly among the Micro-Lepidoptera, which might be adduced. It must not, however, be understood that, as a rule, changes of this kind are wrought in one or even in ten generations. Alteration in the colour of the larva brought about by the agency of food may be observed in *Eupithecia absynthiata* and other species, in which there is a tendency to assume the tint of whatever flower they may be feeding upon; and again, the colour of the silk of which the cocoon of the *Halias prasinana* is formed, depends on whether the larva had previously fed on oak, hazel, &c., We see, too, that species single brooded on one plant have a tendency to become double brooded on another, as in the case of *Orgyia gonostigma* reared respectively on oak and willow. And, finally, with respect to that unsatisfactory pet of the variety-breeder--"the tiger"—many dark specimens have been attributed to the agency of coltsfoot, lettuce, and other *pabula*; but the late Peter Bouchard used to say of one of his best varieties, that he could account for it in no other way than that the beast must have lunched off some bread and cheese which had accidentally fallen into his den.

The influence of light (upon the larval and pupal stages especially), through which it is averred the future imago is rendered darker or paler, according as its action may have been intense and prolonged, or nearly wanting and of short duration, is certainly worth the while of the variety-breeder to test the value of.

Atmospheric influences which operate chiefly upon the pupa, hold a prominent place, and under them may be classed what may be denominated the "thermic," retardation or acceleration of the com-

pletion of this stage; and this, like other causes of variation, appears to affect the individuals of certain species more than of others; for while, on the one hand, it is affirmed that the imago of *Pieris rapæ* is unaffected by the length of duration of the pupa state (the pupæ which should produce the peculiarities of the so-called spring brood doing so whether the perfect insects emerge before or after the pupal hybernation), it is equally patent, on the other hand, that the corresponding brood of *Selenia illustraria* is considerably modified by the length of time which is passed in the pupa state, those pupæ which hybernate producing what is termed the spring brood, those which do not, the so-called "second summer brood," the latter in nowise differing from the ordinary summer brood. Again, by similar agency, we may, as a rule, account for the greater darkness in tint and markings of many northern, and especially Scotch, *Lepidoptera*, as compared with corresponding southern types, since many species double-brooded in the south are single-brooded in the north, and others which here pass but one winter in the pupa stage are apt, in the north, to remain in that state over a second winter, or even for a longer period. Dampness and dryness, too, may be added as atmospheric influences acting chiefly on the pupa.

Glancing back, therefore, we see that the would-be variety-breeder has the option of certain lines of action towards the end he has in view. First and foremost, he may, by judicious selection of the parent stock, enhance his future chances of success, if not in the first, at any rate, in succeeding generations: he may, if he be patient and of a peripatetic turn, avail himself of locality or soil; or he may bring to his aid the influences of food, light, heat, cold, moisture, &c.

It is here, perhaps, just as well to add that direct injuries, by any means whatever, to non-vital parts, especially of the pupa, tend to produce variation, or rather monstrosity, in the imago; but this hardly comes within the scope of variety breeding; it is rather a connecting link between the legitimate art and those ingenious delusions which may be classed as *post mortem* varieties, and which are not infrequently indulged in by the unscrupulous, the sordid, and the envious—I allude to such mordid practices as imitating varieties, or even rarities, by the aid of the paint brush and wasted talent, the manufacture of hermaphrodites, the clumsy artifice of dyeing by saffron and other agents, the conversion of greens into orange, bleeching by exposure to strong light or the fumes of sulphur or chlorine,—impostures which are only mentioned to put the young entomologist on his guard, and which may generally be pretty easily detected by means of the relaxing jar or a strong lens.

The ailments of larvæ have been so little studied that, were

it not that the subject of "Management" seems to demand that attention at least should be called to them, I would prefer to omit them altogether from these notes. For if we except those mysterious maladies, muscardine and cholerine, concerning which untold volumes have been written, with the minimum of practical result, caterpillar nosology can scarcely be said to be even in its infancy.

Direct injuries, such as mutilations, wounds, bruises, &c., resulting from accidents, bites of other larvæ, attacks of enemies, unlucky knocks by the beating stick, or otherwise received, are not necessarily fatal, and to the lovers of malformations, may even be productive of cherishable abnormities in the future imago. We can do little more than leave them to take their chance, placing them out of the way of further harm, and stopping the flow of exuding lymph by the application of powdered chalk to the wound, but of course the scab formed afterwards will interfere with the next moult, so that whenever that event comes about, the larva (if worth saving) may be assisted by means of warm moisture and the mechanical measures mentioned further on under "moulting sickness."

Stings of Ichneumons, &c., come next, and when the eggs of the parasites are not too deeply deposited, and of course before they have hatched, it is often no difficult job to destroy them either by crushing them with finely pointed scissors or pliers, or removing them by the aid of a darning needle, it being sometimes necessary to steady the larva by holding it gently between the finger and thumb of the free hand; but I see no reason why the subject (especially if it be of an irritable temperament) should not be placed under the influence of pure (not methylated) chloroform, since larvæ are readily affected by, and readily recover from the effects of, this agent. N.B.—When stung, the hairs fall off.

Frost bite. It has been stated that larvæ, which have been so stiffly frozen that they might have been easily broken, have been known to recover. The chief thing to be remembered in the treatment of such cases is that the thawing should be effected very gradually—rapid thawing being dangerous; the best thing I can suggest is to cover them up in snow; we should remember that prevention is better than cure, and that the larvæ of species which naturally inhabit warm situations cannot bear, and ought to be protected from, any degree of frost.

Suffocation. This of course happens whenever the passage of air through the spiracles become obstructed, the most common cause *being submersion, for* larvæ have an unaccountable propensity to commit

suicide in the water vessels of breeding cages whenever they can get a chance; still after being immersed for even ten or twelve hours, their case is not utterly hopeless, for though they may appear bloated and stiffened with water, yet if they be dried gently on a piece of blotting paper, keeping them in motion the while, and exposing them to the sun, the chances are that, if they be not too far gone, they will recover; and, for aught I know to the contrary, the school-boy's old remedy of resuscitating drowned flies by covering them up with salt and exposing them to the rays of the sun might prove effective, *only* I have my doubts as to the effects of damp salt on larval surfaces.

Starvation. This may depend on defective supply of food, or the use of an improper diet, or the presence or excess or deficiency of light, as the case may be, may cause the subject of it to sulk and pine away. The treatment is, generally speaking, obvious enough, but sometimes we find larvæ feeding well enough for a time on some particular kind of food, and then unaccountably falling off their appetite; under such circumstances change of diet should be tried, ventilation, &c., should be attended to, light (and even in some cases, rays of the sun) should be admitted; rinsing the food in fresh water, or exposing it to a shower of rain: and as many larvæ have a predilection for sweets, the food may be washed with syrup and allowed to dry, or sugar or treacle may be added to the contents of the water vessel with a view to imparting a flavour to the food; in the latter case, however, we must be careful that the mixture become not mouldy or acetous.

Surfeit. Many larvæ, especially such as are large and smooth, when permitted to gorge themselves with two juicy food, have a tendency, particularly when about three-quarters grown, to become dropsical and die. The remedy would appear to be to feed them on dry mature leaves gathered from bleak exposed situations, and moisture should be excluded from the cage.

Cramp. A night passed on a cold surface is often sufficient to paralyse the pro-legs of larvæ, especially of such as are young and tender; under these circumstances they are unable to retain their hold when placed upon their food: perhaps the best plan is to put them on some such surface as a piece of blotting paper, in a temperate situation, fresh leaves of the food-plant being strewn about within reach of the sufferer.

Low Fever. Undoubtedly larvæ suffer from a contagious disease *very analogous to this.* Some species are more liable to it than others,

and it appears to be very fatal among the members of any affected batch, though apparently not communicable from one to another, and distinct, species. It is doubtless engendered by bad feeding, ill ventilation, proximity of decaying vegetable or animal matter, &c.; the indications therefore are that these should be removed as early as possible, and the healthy larvæ should be kept separate from those which show the slightest signs of the disease. The use of a small quantity of Condy's disinfecting fluid in the water vessel, too, could do no possible harm, and might prove beneficial. Somebody has suggested that immersion in cold water has a beneficial effect in this disorder.

Irritability. Some larvæ are naturally of a waspish, irritable disposition, biting and striking violently at anything or any other larvæ which may cross their path or come in contact with them; others become ill-tempered during, and for a short time after, their moults, when the skin appears to be very sensitive; or this irritable state may be due to the recent sting of ichneumons, the presence of acari, &c., requiring our attention. Larvæ thus affected should be kept as little crowded as possible, and, indeed, if necessary, confined in separate cages.

Moulting Sickness. Larvæ of some species, even in confinement, appear to experience but little difficulty in casting off their effete skins; others, on the contrary, and of these chiefly those of the Butterflies, Sphinges, *Bombyces* and *Pseudo-bombyces*, apparently naturally undergo a comparatively tedious and painful process of ecdysis; the appetite of the catepillar thus affected leaves it, it frequently seeks some retired spot, and having spun a fewer or greater number of silken threads, attaches the hooks of the pro-legs thereto, and then, after the lapse of a longer or shorter interval, bursts the now useless covering which invests it, and makes its exit. During all this the larva should, as a rule, be left to its own resources, but sometimes it may be observed that it is incapable of freeing itself, in which case assistance must be rendered before prostration takes places, by slitting the old skin with a couple of needles carefully manipulated, cutting, by very fine pointed scissors, the skin round any scab which may have been formed over a wound, and pegging down the skin in cases where the pro-legs may have become detached from the transverse silken threads, assisting meanwhile the operation by moisture and warmth. It is very important to discriminate between the above sickness and cases of starvation, since the treatment required in the latter case is necessarily converse of the above, and a conclusion respecting this may safely be arrived at by attention to the following:—In *the starved larva the* capital segment is comparatively of hydrocephalic

proportions—it is, in the moulting larva, very small; the skin is plump and tense in the latter, while that of the former hangs loosely; the silken transverse threads too are absent in the victim of starvation, which also exhibits a restless desperation in searching for food to appease its hunger, sometimes snapping at pieces of frass and other substances, and as hastily casting them aside, the moulting larva, on the other hand, remains stationary.

Diarrhœa. This is generally caused by improper feeding with too juicy or too relaxing food; in such cases, dry stunted foliage gathered from bleak exposed situations, mature leaves, astringents, such as dark-coloured oak leaves, madder, &c., should be tried with such larvæ as will partake of them, or the food may be sprinkled with powdered madder, chalk, &c. The converse of this complaint requires to be treated with the young, juicy, immature leaves of the food-plant, and, in certain cases, mostly among the *Noctuæ*, the administration of lettuce and other natural purgatives will have a salutary effect.

Fungus. This is particularly apt to attack hairy larvæ, especially such as hybernate, the subject—having doubtless first become unhealthy from confinement in a damp, ill-ventilated atmosphere—is attacked by a species of *öidium*, after which it is generally "all up." I do not know how far the use of hyposulphurous acid or the hyposulphites might be applicable, but their effect might be tried. The natural preventive is, doubtless, exposure to the sun's rays, and most collectors must have noticed that the hybernating larvæ of *Arctia*, *Spilosoma*, and others, take every opportunity of sunning themselves, as if for the purpose of drying their coats; when there is no sun visible, currents of dry air will, probably, be the best remedy.

Observation.

Compared with the other stages, the larva state possesses the greatest interest, not only as being the disguise of the future insect, but because in this condition, all its growth takes place by assimilating to itself a certain amount of vegetable sustenance. Their forms, habits, &c., are also remarkable.

The quantity of food consumed by the larvæ of many species is very moderate, and their full growth is soon attained, while other species eat an astonishing quantity, and their slow growth seems quite inadequate to their insatiable appetites and prolonged larval existence; they seem

as though appointed to defoliate trees and plants. In this respect the smallest species, especially when gregarious, sometimes exceed in mischief the larger kinds.

Our hedges and gardens frequently arrest our attention by the ravages they betray, and forcibly remind us of the Egyptian plague of caterpillars that devoured every green thing that was in the land.

Few persons of ordinary intelligence ever see a caterpillar without feeling an interest for its beauty of colour, or singularity of structure, and perhaps, also, in connection with associations that accompany a creature, whose whole life is devoted to eating. But there is, unfortunately, with ignorant rustics, too frequently a temptation to crush the unoffending worm, especially if of unusual dimensions, and under the vague idea of a "locust," doubtless, many a rare and beautiful form is often ruthlessly destroyed.

But larvæ also claim our interest for their wonderful structures, and the immense amount of variation to be seen in their textures of skin, forms, and colours. Some have skins of velvety softness, others of shining brilliancy, while some species are rough and shagreened, and some partially hairy, others densely clothed with hairs: a great variety exists. In some the hinder pair of legs are wanting, and an elongated tail substituted, as in the *Drepanidæ;* and the genus *Dicranura* gives examples of double or forked tails, *Vinula* is a striking instance, quaint, and grotesque, with its air of ridiculous anger when alarmed or its dignity offended, at such times, it erects its head and tail, protruding the fleshy filaments telescopically from them, then raising itself to its full height and swinging to and fro the thick anterior part of its body, in a jerky way.

If we turn to the *Diurni* we find in *P. Machaon* a beautiful example of a smooth-skinned larva furnished with forked tentacles protruded at will behind the head, and accompanied by a pungent acid odour.

And in the larva of *Apatura Iris*, we behold the two lobes of the head extended upwards, and produced into two occipital horns, its body tapering behind to a pointed and slightly divided tail; and very suggestive of a slug in form.

In the genus *Vanessa*, and some others, the larvæ are encased in defensive armour, which no doubt appears formidable generally to the eyes of birds, their backs and sides bristling with several rows of branchial spines, a perfect *cheveaux de frise.*

Thecla Betulæ, with its front segments sloped and flattened above towards its diminutive head, appears like a limpid green slug adhering to a leaf. And the popular idea of a wood-louse has often been attributed to the shape of *Lycæna Alexis* and its congeners; indeed, as contrary

are they to a beginner's notions of what a butterfly larva should be, that he may likely enough refer them to some other order. In the larger larvæ of the *Sphingidæ*, we see them having a curved horn pointing backwards, like a veritable tail, and in the *Smerinthi* another variation in the form of the head, which is triangular in shape. These larger hawk moth caterpillars are familiar enough; but it is not without some misgivings that the soft whitish maggots of the *Sesidæ* are for the first time accepted as the early stage of the clear-wings.

Chærocampa elpenor has its front segments rapidly tapered towards its small head, and it can elongate them at will, reminding one of the prehensile trunk of an elephant, or contract them in such a manner as to give it a hunch-backed look. Then in the tribes of hairy larvæ that succeed, what variety of arrangement is to be noticed in the tufts! and it is strange also, to find this hairiness suddenly appearing in a species here and there among the *Noctuæ*, and even in the *Geometræ* (*Aplasta ononaria*), not to mention the Plumes.

In the hairy larvæ of *Dasychira fascelina* and *pudibunda* we see bundles of hairs so disposed as to look like veritable shaving brushes on their backs, and a longer tail-like tuft behind, while *Orgyia gonostigma* has in addition on each side in front a long whisk of hairs, with clubbed tips, standing upright like horns. A large number of genera amongst the *Nocturni* are hairy, and we may mention *Arctia Caja* as an example of a larva having raised wort-like tubercles, from which hairs diverge in all directions, so as to completely hide its body beneath them. Others are densely clothed with parallel hairs, growing in various directions, a familiar instance of which is known in *Bombyx quercûs*.

The genus *Psyche* shows us larvæ inhabiting cases made of bits of heather, stems of grasses, particles of leaves, &c., &c., and the movements of such strange objects are very curious; only one or two segments of the occupant can be seen when it is in an active condition.

An ominously threatening creature is the larva of *Stauropus Fagi*, especially when alarmed: its front segments are furnished with remarkably long angular jointed legs, which it plays with a tremulous motion, and its hinder segments are enormously inflated and erected, and terminate in two filamentous tails, making one hesitate before touching such a scorpion like object when met with for the first time.

Notodonta ziczac is a very striking form, when at rest its head and tail is erected, and its body bent and arched, which curious posture is rendered more striking by a hump behind, and two long curved ones on the back.

Lophopteryx camelina is remarkable for having, in addition to a slight

hump behind, two short fleshy projections, bearing two or three hairs, and its favourite posture in repose is to bend back its head and front segments, and elevate the hinder ones into a curve that seems exhaustive of muscular power.

In the group of *Noctuina*, the great bulk of species are remarkable for having smooth skins, and as being, in a general way, tolerably uniformily cylindrical, yet they present great variety of proportion between length and thickness.

Cucullia verbasci is a good example of the few smooth, brightly-coloured larvæ that feed by day; these conspicuous fellows seem to be sufficiently acquainted with the idiosyncracies of their avine and other enemies, to be aware of a noble trait in their character, which may be likened to that of the Sportsman who despises a battue, or a man who prefers to work for his living, rather than pick up a loaf at the Union; for though birds certainly will devour them readily enough, when put to the shift, and do not seem to object to their flavour, they certainly prefer *hunting* for their game—so do I.

Amongst the *Geometræ*, with ten legs, we see some very remarkable forms, distinct from any of those previously mentioned; in most instances the anterior and posterior segments being much shorter than those of the middle, that are not furnished with legs. Some are very elongated, as *O. sambucaria*, others short and twig-like with prominences, as *R. cratægata*, which, by-the-bye, has the exceptional number of fourteen legs; and in *P. syringaria*, we have a larva of great singularity with two pairs of projections on his back, the hinder ones elongated and curved generally keeping itself in a close loop-like form.

The larvæ of *Selenia* are very like thorny twigs, the hinder pair of the anterior legs having much the appearance of thorns, the humps and swellings behind favouring the resemblance.

A. betularia is not easy to detect from surrounding twigs of oak, with which its form exactly corresponds. In short, examples of the forms of every kind of twig, gnarled, knotted, prickled, rough and smooth, are represented marvellously amongst the *Geometers*. And even so accomplished a larva-hunter as Mr. Hellins himself confesses, that in the space of an hour he not only mistook the larva of *Angerona prunaria* for a twig of mountain ash, but also, a twig of mountain ash for a larva of *A. prunaria*.

Geometra papilionaria presents a larva with forked head, and a fork on the next segment, and having humps, and a shagreened skin, looking not unlike a birch catkin for which it might readily be passed over; and *Phorodesma bajularia* clothes itself with particles of leaves in such a manner as to entirely disguise its larval appearance.

It is perhaps, now-a-days, rather dangerous ground to tread upon; but still to the practical Entomologist—collector, if you will—there is something very interesting, in more senses than one, in the wonderful powers shown by larvæ in defying detection, and one cannot resist just skimming the surface here with a few words—not stopping too long, lest some angry philosopher, with a sledge-hammer theory on the struggle for existence, should demolish the brains of the poor fly catcher who dares to trespass on his domain.

Those twig-like larvæ that feed on birch, invariably assimilate to the stems of the tree, the same may be said of oak and other tree-feeders: those that make broom their food are found to be green, exactly like the twigs of the plant, and the smaller geometers that feed on low plants, generally imitate the stems; to this wise provision, as well as to their rigid and immovable postures during the day, may be ascribed their safety. There are some few gaily coloured species though that spin leaves together, and feeding between them, are thus screened from observation. The greater portion of the *Noctuæ* keep themselves during the day in strict seclusion, asleep in their various retreats, coiled up in dead leaves, or hiding in reed and other cut stems, at the roots of grasses, or under stones, often in chinks of and under bark, and even burrow in the earth; while some few are in the pods amongst the seeds of plants that are appointed them for food, between united leaves, &c., all these seem to have the greatest aversion from the light of day, and when accidently or otherwise exposed to it, evince it by waking up and crawling rapidly until they can find shelter and concealment. But the naked larvæ, whose soft bodies are tempting to birds, seem to be so endowed with instinct for their own preservation, that but few naturally venture forth till their enemies have retired to rest. These play a life and death game at hide and seek.

It is true that the few that boldly remain on their food plants by day, and even bask in the same rays, are very brightly coloured, and easily seen by us; and their is little doubt, but that either they are not fair game or are not sufficiently tempting objects to birds in general, otherwise, they would assuredly be less numerous than they appear to be.

The safety of many larvæ of Butterflies that remain by day on their food, is owing to something objectionable in their odour. Poultry appear to have a great dislike to the larvæ of *Pieris brassicæ*, frogs to *Abraxas grossulariata*, &c., &c., which if offered to them they retire from in disgust, and though tomtits, creepers, and other preying birds are on the watch for *larvæ that hide in crevices of bark or chinks of walls*, we do not see that

they devour the gregarious larvæ of *Hyponomeuta padella*, that swarm in multitudes on apple trees and hawthorn hedges, even though the contents of a web would be a cropful.

Amongst the *Bombyces* and other larvæ that may strictly be termed hairy, if we except the cuckoo, which has the reputation of a partiality for them, we do not know of any other feathered enemy to molest them; for doubtless birds are much in the same way of thinking as the Frenchman, who exclaimed, "Be gar, ze yolk of ze egg is ze chicken, boot ze vhi-i-ite is ze fedders, I sall not eat feddars to make myself into a polster."

A large number secure immunity from the attacks of birds, &c., by the very nature and conditions of their existence, passing their larval lives, as they do, in excavations in the trunks, branches, or bark of trees, the stems or roots of plants, or feeding in galleries above or below ground, or, for the matter of that, existing under water, but even these do not always escape decimation by the attacks of insidious parasites.

Amongst some of the smaller groups are species that weave together scraps of vegetable substances into dwellings of various configurations, within which they feed and escape observation in general, as mere particles of vegetable refuse; others fabricate neat cases for their protection from the materials of their food.

Thus, we see, larvæ have the power in many ways of warding off their enemies, they may put their trust simply in faith, like a missionary among savages, or strike terror with horrid forms and gesticulations, as the Chinese do—they can wriggle like an eel, leap like a salmon, swing like a Leotard, or run like a Deerfoot upon occasion, they play at whoop, only they do not halloo—sometimes they make excavations in wood, earth, or other material, like veritable sappers and miners. They take advantage of their forms and colours to mimic various objects, or they dress themselves up like a jack-in-the-green—a few like the celebrated Slingsby, who vanquished the snapping turtle in the dreary dismal swamp, are clothed with formidable armour, but a more despicable class, parody the cuttle fish, or even come the skunk; and lastly, not a few hirsute customers are evidently of too indigestive a character for any maw.

There is much to excite our interest in the various times, as well as modes of feeding; the morning sunshine, the rays of the hot afternoon sun, at dusk, and afterwards, when their food is bathed in dew, and, indeed the moisture seems to whet their appetites, as much as the darkness, seeing that they often start out for a feed after a shower, some feed on and off by day or night, but perhaps the early dawn is as favourite a *time as any: a few* remarks on this subject will be found at pages 19-20 *ante.*

As to modes of feeding, some make holes in the leaves, some eat the upper or under skin of the leaves, some live between the skins, some will not eat ribs and so leave a network, some leave the midrib, some —big ones—clear ribs and all, some love to eat in company, some abhor a companion and bite him or eat him up, some eat solid wood, some pith, some bark, buds, leaves, flowers, fruit, kernels, pips, some roots, some live under ground and put up their heads and eat leaves which touch the ground.

But interesting as are these habits, yet how much more so when we come to consider the wondrous instinct they all display in securing a proper situation for their approaching change to the pupa state, not only with regard to the exigencies of the wonderful operation itself, but their perfect modes of concealment, so important for their coming helpless condition.

Amongst the Butterflies, some attach themselves to projecting ledges, copings, &c., of walls, or under angles of branches of trees, others to stems of plants, or hang from the roof of their compact tent of leaves spun together; some of the genus *Thecla* tie themselves to the assimilating stems of their food in an upright position, where they appear like very natural swellings on those parts, while others even enter the earth to escape detection, and some of the *Satyridæ* and *Lycænidæ* repose on the surface in slight hollows of the earth, or partially attach themselves to the stems close to the ground, trusting, with their unerring instinct, to their dull colours and inconspicuous forms, assimilating with the debris around them.

The *Hesperidæ* enclose themselves in a kind of fusiform abode, by drawing together the two edges of the middle or lower part of a blade of broad grass.

To save repetition, cocoons will be considered further on, when we come to discuss the chrysalis state, for although they are certainly the work of the larva, they are, nevertheless, constructed for the special benefit of the pupa.

It is a most important thing to observe carefully the appearance of the little larva as soon as hatched, and also at every moult or change of skin; for without knowing its appearance at particular stages of growth, we feel puzzled to know even the very commonest of species.

For want of this observation the larva of *Acronycta alni* is even now only identified after its last moult, when its long clubbed hairs and black coat banded with yellow betray it as a rare species, and it never fails to arrest attention by the singularity of its structure; but it is to be regretted that its previous history and appearances have not been described.

In many species the continued changes at every moult after their exclusion from the egg afford a great source of interest to the breeder, but these changes have, in some instances, been productive of mistakes by certain authors in their descriptions.

Amongst a large number of larvæ that in their earlier stages are comparatively sober in colour, and only array themselves in brilliant coats at their last moult, may be mentioned *Lycæna Ægon*, *C. flavicornis*, *A. australis*, *T. rubricosa*, *E. nigra*, *C. exoleta*, &c.; while, on the other hand, a considerable number amongst the *Noctuæ* are more gaily dressed in youth, and take to more quiet colours as they approach maturity: some that have but little variety of markings through their whole larval career, yet entirely change their colour, as from pale green to dark brown, or *vice versâ*.

What to observe.—For a complete history of species, it is of course necessary to begin one's observation with the exit from the egg: Do all the batch come out simultaneously, or at intervals?—at what part of the egg is the exit made—the top or side—by a big or small hole—*i.e.*, does the egg-shell remain tolerably whole, or much shattered? Then, again, is the egg-shell eaten for the first meal? Then the colour and form of the young larva—should be noted; for some species, such as *C. immanata* and *russata*, may be seen to be distinct then more easily than at any other time of their larva life; also whether it has bristles which may afterwards fall off, or horns or ears (as in *Vinula* ——) which may afterwards sink into the body; of course young larvæ, like many other young things, have big heads, but a meal or two will cause the body to assume its proper proportions, unless the head is to remain strikingly bigger than the next segment. In a general way, therefore, this feature need not to be noted as any peculiarity.

Next we observe the change of colour produced, it may be, by the food, for young skins easily show what is going on inside, and blush green generally at first, till time thickens them.

Then as to how they feed, &c.; how they behave when touched; whether they fall off, curl up, fling themselves about, jump backwards, try to bite, drop by a thread, sham death, &c., &c. And a very important element in giving a life-like idea of the larva is its *attitude*, whether at rest or in motion; whether it rests at length, or bent or curled, and if the latter, whether curled sideways or in the same plane, and if so, into how many coils?—time taken in feeding up, which will also be influenced *by feeding* with proper food, for some will collapse if they can't get *enough—others will* starve on, and grow again when they are supplied.

Then about hybernation—if so, when begun, when ended? how many spring *moults?* there is generally one, but sometimes more.

The structure, as well as the colours and markings of the larva, after every change of skin, should be carefully noticed, as well as its habits and customs, which are often peculiarly interesting, together with its food-plants and the effect of any experiments made with them. When these have been done and the figures have been taken, we may congratulate ourselves on knowing something about the natural history of *Lepidoptera.*

How to describe.—With a view towards helping on a more uniform system of describing larvæ, the following *hints*, founded on experience, are thrown out.

It has been suggested that some (one or more) common larvæ, or any one species in each of the greater divisions of *Lepidoptera*, should be taken for a standard, and a newly-described species might be compared with these, as to the proportions of their bulk, &c., &c., and so a more definite idea of what is really meant might be at once conveyed to the readers. Perhaps, however, it would not be easy always to get a living specimen of the standard to refer to; in that case, as life-like a figure as art could perfect of the species selected might be given in such a work as Stainton's Manual—always ready to be used. The only question is, whether this system would further the desired end or not, or whether it would be possible for describers to agree in the selection of the species for standards? Certain it is, that when we read the description of any thing new, we are sure to make some sort of picture of it in the mind's eye, and we do this by the help of memory; so with larvæ, when we read the account of some hitherto "unknown," we are sure to be comparing what we read with our recollection of other species, and so make out for ourselves a mental image of the stranger—too often a wrong one after all the describer's pains. Of course it is comparatively easy to describe many larvæ very briefly, if nothing more is done than to say the colour is green or brown, and that there are some white or yellow lines, or some black marks on it; but such descriptions are really of little use. The plan adopted in Stainton's Manual of giving the generic *form* of the larvæ at the head of each genus, reserving the colour to be given under each species, is, of course, a great advance on the former plan; though when the genera consist of one or two species only, this comes almost to the same thing as giving the form of each species, and when the genera are longer, we find that there are cases where the imagos form a natural group enough, but the larvæ refuse to adapt themselves to the family *arrangements; as in Acronycta, Agrotis, Acidalia, Hybernia, Eupithecia,*

Melanthia, *Melanippe*, and *Cidaria*: still no doubt there are certain forms always to be associated with certain groups of *Lepidoptera*, and we can talk of a sphinx-like larva, a puss or kitten, a *Bombyx* larva, or a thorn larva, with a good chance of conveying at least some approximate notion of what we mean.

But whilst guarding against a too concise method of description, it is not altogether unnecessary to utter a word of warning against setting forth the *individual peculiarities* of our examples as necessarily distinguishing the species; and here experience and careful observation must necessarily tell very much; for without these one cannot be sure what to pass over or what to insist upon: perhaps the difficulty is best obviated by the describer being modest enough to say that he is speaking only of what he has himself seen, and is not legislating *ex cathedrâ* for all generations of collectors and all broods of larvæ from the inspection of a single specimen; and this remark applies with equal force to the dates in the life of a larva or a brood of larvæ; because one brood in confinement are hatched, or commence spinning on a certain day of their existence, it by no means follows that all individuals of that species all over Great Britain are bound to do the same! and the wording of our notes would be more truthful if modified accordingly.

Supposing, then, we have a larva before us awaiting (or, as unfortunately is generally the case, trying, either by sullen immoveability or by frantic racing, to avoid) description, it will, as a rule, be found best to give *first* its length, bulk, and form, and *secondly*, its colour and ornamentation; otherwise, there is danger in many cases of the colours getting (grammatically) put upon the wrong parts.

State then first the length, both at rest and in motion—if many examples can be examined, the average length; if the larva is contractile; then the bulk in proportion to the length, whether stout or slender; for instance, one calls the larva of *Triphœna orbona* plump, but tolerably proportionate to its length in bulk, while *pronaba* is more decidedly *stout*, and *Gonoptera libatrix* slender; then give the shape of the head—whether globular, flattened, square—whether notched or bifid, whether retractile or exserted. After that comes the outline or form, and this may be taken at two views—first from above, and then sideways; and will be set down as uniform, swollen in any part or tapering, cylindrical or flattened; some cases admit of a single word describing much in a small space, such as spindle-shaped, or, if liked better, fusiform; in others it must be done more at length, mentioning whether the segmental folds *are deeply marked* or otherwise; next in due order, plates, humps, and *the shape of the humps*, such as globular, pyramidal, wedge-shaped,

single, or in pairs, &c.; ridges on certain segments, and also their position—dorsal, lateral or ventral; then appendages, mostly anal, but not always so; in the case of regularly hairy or tufted larvæ the point of hairiness, with the position, length, nature and distribution of the hairs, whether bearing short bristles or longer hairs; then will come the texture of the skin—translucent, soft, smooth, glossy, shagreened, folded, wrinkled, puckered, and whether the creature is tough to the touch or pulpy; with the usual warts or dots, whether obsolete or distinct.

A few words are here necessary. Firstly, Lepidopterous larvæ all fall under the general description of being divided by indentation into thirteen segments, whereof beginners must remember that the head is number one; although in some descriptions copied from old writers it seems as if the head were excluded from the reckoning, and the number of segments set down as twelve only. In a general way, too, it is not very wrong to say that larvæ are long and cylindrical—so many species are really of this form that it may fairly be taken as the type. But of course when we come to pass any great number of species in review, we find their variety, both in form and ornamentation, to be wonderful.

Secondly, the tubercular dots amongst the larvæ of the Noctuina and others, from each of which grows a single hair or bristle, are evidently organs of feeling, and their arrangement as to situation and number can be best studied from the larva of either *Agrotis segetum*, *Gortyna flavago*, *Dasypolia templi*, &c., in all of which they are conspicuous as horny warts, and when once they are understood we shall find their representatives in a vast number of species in each division of *Lepidoptera*, that is to say the hairs, however minute, will be found if carefully looked for in similar positions; so that whatever may induce a note on them, it will not be at all necessary to allude to the position they occupy, which should be evident in the minds of all Entomologists.

Thirdly, where there is any departure from the usual number of legs, that is a most important thing to be mentioned, and should come very early in the description; for unless anything is said to the contrary, we assume, in the case of the larvæ of butterflies and thick-bodied moths, and Pearls, that they have 16 legs a-piece, and in the case of the geometers only 10 legs; deviations from this rule ought, therefore, to be carefully noted, and also cases of imperfectly developed legs, or legs changed into something else, as in *D. vinula*, &c.

Fourthly, it must be remembered that the anal segment is apparently sub-divided on its upper surface by a transverse indentation on skinfold, which is in *fact the hinge*, so to speak, of the anal flap, and has often been *misrepresented*, even in our own day, in pictorial works as an extra

segment, whether from want of knowledge of the external anatomy of a lepidopterous larva or from careless haste, it is hardly possible to decide, but the numerous mistakes of this nature that exist in otherwise well-executed engravings, from whatever cause, are much to be regretted.

And lastly, the third, fourth, and thirteenth segments have no spiracles, and those on the second and twelfth are placed a little higher than the others, and are generally a trifle larger, and of a more narrow oval shape, so that as this arrangement exists in all, it is only necessary to describe their colour, unless those on the middle segments should happen to be circular, a circumstance worthy of note.

The bulk, form, proportions, structure, texture, and organs, of the larva having been duly discussed, then comes the—oftentimes puzzling—task of setting forth its colours, and their arrangement.

And first we may notice, that in most cases the larva has some colour or other predominating on the back—sometimes reaching down to the spiracles, sometimes not so far—this then should be taken first, as the *ground* colour; then comes the colour of the head, with the lines, if any, on it, and starting from these come the lines in so very many cases running through part or all the dorsal region; chief of these is the dorsal line, sometimes merely seen as a pulsating vessel through the skin, sometimes being a line or stripe of colour in the skin itself; then where the back slopes decidedly to the side, comes the sub-dorsal line, and below that the broader stripe, at the bottom of which the spiracles are usually situated, termed the spiracular, all these three lines may be bordered by others, or the space between them may be filled up by similar lines, or they may be interrupted, and appearing as continuous lines only on the front—the middle or the hinder segments and be seen only as dots or streaks on the others; still they are to be made out more or less distinctly in the majority of species, and greatly assist one as land-marks, so to speak, in mapping out the surface of the skin to be described.

Sometimes lines are quite discarded, and transverse bands are all the rage; and will have to be distinguished, some as being of the ground colour, and others as marks on it.

Lines and bands are easily put out of the way, however many they may be, in comparison with *patterns*, which puzzle one immensely for words to describe their outlines and positions; still, if the position of what should be the dorsal and sub-dorsal lines is well kept in hand, the place also of the fold between the segments noticed, and the existence more or less apparent of the (trapezoidal) dots or warts not forgotten, it *will often be found* that very intricate patterns will resolve themselves *into comparatively simple* elements; and if their outlines can be com-

pared to any tolerably familiar object (such as a pear, a kite, a lozenge, a diamond, a boat, a V or a W), a better notion can then be more easily given than at the expense of a much greater number of words achieving the same end in a round-about way: the direction in which these patterns point should not be forgotten; as also in the case of slanting streaks or dashes.

The back having been more or less successfully got rid of, then come the spiracles, their shape and colour, followed by the colour and markings, if any, of the belly; sometimes this is plain enough, at others it is prettily decorated with lines, and in the case of *Melanthia ocellata*, there is a V-like pattern as distinctly as the back; the colour of the legs also must not be forgotten, and may be given in connection with that part of the body to which they most assimilate. The humps, &c., are to be distinguished from the part of the body on which they are placed at the time it is being described.

In many closely allied species the utmost care and attention should be given to the back, and more especially the region of the sub-dorsal, for it is there that the distinction and special characters are formed, and without this close investigation, we should not be able to discriminate between many species of the genus *Noctua*—and again the genus *Leucania* is another that demands the closest scrutiny, on the sub-dorsal region, as these larvæ have all an uniform design on them of a certain number of lines and stripes, excepting, of course, *Turca* and *Phragmitidis*, which appear to have no claim to the genus in the larval condition.

NOTE.—A line is so called when thin, but if thick it is termed a stripe. The dorsal stripe generally represents a pulsating internal vessel, often edged with darker thin lines—and in young larvæ these lines are distinct, though very close together, and the dorsal is then called a double dorsal line; an extra broad or remarkably wide stripe is termed a band.

Preservation.

The art of preserving the skins of larvæ has, of late years, made rapid strides towards perfection, both at home and abroad. By the recent process, hairs and appendages remain intact, the colour and markings are happily secured, and even in the matter of form, considerable advancement has been achieved.

Any body can understand that great care and patience are required, *that the occupation is* not without personal inconvenience, and that

more or less frequent disappointments must occur. It is therefore not to be wondered at that those who have devoted themselves to the practice of this art, look forward to remuneration, and, pursuing it for profit, they cannot be blamed for keeping their secrets to themselves.

The following method I tried many years ago with tolerable success. The larva was first killed by immersion in spirits of wine, then the contents were extracted through the anal orifice, by means of a crochet hook, or darning needle with the point turned round whilst red-hot, after that the skin was inflated, and kept so with a fine blowpipe inserted and secured in the above-mentioned aperture, care being taken not to distend it too much, and at the same time it was dried as quickly as possible before a fire. Were I again to make an attempt, a metal chamber heated by gas would be substituted for the fire. Fine sand has also been employed to keep the skin distended until dry, by this means the form may be better secured, but the process is not so speedy, or otherwise desirable. Parts that have faded during the operation, may be tinted by the application of colour, on a camel's-hair brush of the smallest size, to the interior of the skin. The object should then be mounted on an artificial leaf, the more like one of its natural food-plant of course the better.

END OF CATERPILLAR STATE.

THE CHRYSALIS STATE.

"*Sans* teeth, *sans* eyes, *sans* taste, *sans* everything."
SHAKESPEARE.

Collecting.

Although, compared with the other stages of Butterfly and Moth life, Chrysalides are for the most part sombre, uninviting objects; still as links in the cycle of changes they ought to be studied.

Locomotive movements are rarely performed by these torpid creatures, the exceptions being the pupa of *Macrogaster arundinis*, and perhaps other internal reed-feeding species which, probably for the wise end of escaping the effects of floods, are endowed with the power of travel-*ing up and down the* stems which encase them. The pupa of H. lupulinus

lives in an elongated cocoon somewhat like a gallery amongst fine earth, and on being disturbed can move itself from end to end of its house. Then, too, many pupæ, shortly before the emergence of the perfect insect, are able, by means of more or less toothed annulations, to wriggle themselves towards the daylight; this has been noticed in *Ch. elpenor*, *Cossus*, *Zeuzera*, *Hepialus*, the *Sesiæ*, and others.

Movements of pupæ generally consist of jerking, writhing, and wriggling, but that of *Ligdia Bennettii* (I believe also of *Pt. bipunctidactylus* and *Loewei*) assumes a ridiculous posture, curving itself upwards previous to the final transformation.

But if chrysalides of Lepidoptera are, generally speaking, dull, stupid-looking things, there are, at any rate, many beautiful and curious exceptions to the rule; among the butterflies, for instance, we meet with some gracefully angulated forms, resplendent with burnished gold, fully accounting for the derivation of the word "chrysalis:" while that of *Nemeobius Lucina* almost anticipates the hairy pupæ presently to be mentioned, and is, besides, ornamented with a row of black dots on each segment. The pitcher-handle-like proboscis sheath of the pupa of *S. convolvuli* is a curiosity in its way; the tufts of hair in the case of certain *Bombyces*, the funny ventral appendages at the ends of the wing-sheaths of the puparium in *Dianthœcia* and *Cucullia*, observable also in *Plusia*, but not so strongly marked, and exaggerated in a grotesque manner in some of the *Hydrocampidæ*; the delicate blue bloom on *Cosmia*, *Mania*, *Catocala*, *Cidaria psitticata* and *miata*, as well as on *Halias prasinana*, the old larva-skin attached tail fashion to the comical squat pupa of *Pericallia syringaria*, the green and orange-red colours of the *Therœ*, and the wonderful variety of tints and markings in the chrysalides of *Eupithecia*, pointed out by the Rev. H. Harpur Crewe, and the quaint hairy-looking articles, which will bye-and-bye turn out veritable plume moths, are all more or less interesting and instructive; and, indeed, to any body who will take the trouble and look at them carefully, there is vast variety, even in the common brown pupæ of so many species—their heads, shoulders, wings, abdomens, all slope at such different angles, or take up such different proportions of the whole figure of the pupæ; and, again, there is much to be seen in the spikes at their tails—blunt, sharp, bifid, hooked,—in fact, one can give no notion of their variety without specimens or figures.

Then, again, though some pupæ are quite unattached, *e. g.*, the lively *Macrogaster* before mentioned, others, thanks to the supply of silk and ingenuity possessed by the larvæ, are curiously attached to surfaces, thus those of the *Nymphalidæ*, *Vanessidæ*, and of the Pterophori, are suspended *by their anal segments*; but though Tom Hood, in one of his whimsical year

books, draws an unmistakable *Noctua* pupa hanging by its tail, head downwards from a tree, no notice has yet appeared of such a monster in any veracious periodical; others in addition have the further support of a silken girth, as in the *Papilionidæ*, and some of the *Lycænidæ*, among *Rhopalacera*, the quaint truncated butterfly-like little pupæ of *Ephyra*, among *Geometrina*, and of *Rivula* among the *Deltoides*; again, to the larva is due the wonderful insect architecture displayed in the construction of cocoons, or the rudiments of them; sometimes only a few silken threads, attaching together leaves or rubbish, serve as a protection for the contained pupa, as with *Pericallia*, *Abraxas*, *Angerona*, *Ennomos*, &c.; the chrysalis of *Uropteryx* is suspended by a few threads in a sort of cradle; more or less slight cocoons formed among mosses contain the pupæ of *Lithosia*, *Endromis*, *Tephrosia*, *Geometra*, &c., and similarly amongst leaves, *Tethea*, *Cymatophora*, *Amphipyra*, the *Botydæ*, *Pyrausta*, *Hypæna*, *Herminia*, *Odontia*, &c. Some of these slight cocoons are perhaps more beautiful than any others, from the net-work form in which the silken threads are woven; *Acidalia subsericeata* and *Sterra sacraria* are examples of this, but *P. porrectella*, though these notes do not include *Tineina*, is as beautiful as any. It is among the *Bombycina* that we find above ground the most perfectly formed cocoons, and here there is much variation; first in density, those of the *Liparidæ* being gauzy web-like affairs, *Clostera*, *Porthesia*, the tigers, ermines, &c., more or less mixed up with hairs—a peculiar sulphury substance enters in the composition of that of *Clisiocampa neustria*, and *débris* of wood into those of the internal feeding *Cassus* and *Zenzera*—then, in the next place, as we get to tougher material we find considerable variety of form, thus the cocoons of *Odonestis* and *Gastropacha* are elongated and somewhat fusiform, the little cocoons of *Nola* approach the shape of a boat, that of *Saturnia* is pear-shaped, with a singular valvular opening, the *Eggars* have smooth egg-shaped cocoons, thence their name, and lastly the cases of the *Dicranuridæ* are of great hardness, that of *vinula* presenting the appearance of a half-egg, whether made out of bark or fragments of a stonewall or a painted door, should the larva choose to leave its tree, and betake itself to a neighbouring building for making up; that of *bicuspis*, when we get it out, bears a striking resemblance to a Brazil-nut. In other divisions than the *Bombyces* we find examples of well-formed cocoons, thus the *Anthrocera* are furnished with neat glazed cocoons elongated at each end, those of the *Sesiæ*, are miniatures of *Cossus*; *Acronycta*, *Synira*, *Abrostola*, and others among the *Noctuæ*, have a more or less tough and silken covering, *Scoria dealbata* is enclosed in a shuttle-shaped cocoon, *Halias* in a boat-shaped one, while *Phorodesma*, *Pysche*, and some of the Hydrocampidæ content themselves with the old habitation of the larva.

This brings us to mother earth, and it is now chiefly with the *Noctuæ* and *Geometrina* we have to deal; some, as *Xylocampa*, *Bankia*, *Metrocampa*, *Eupisteria*, are found on the surface, others, as *Rusina*, a little beneath it, the bulk are situated at a depth varying from an inch and a-half to three inches in depth, while a few lie buried at a very considerable depth, as in the case of *A. Atropos*, *P. cassinea*, some of the *Agrotes*, *Calocampa*, *T. populeti*, &c., but the depth of all pupæ will depend much on the nature of the soil. In the construction of these earthern cocoons there is of course great similarity, though there is much variation in the relative quantity of silk used to bind the earth, in some instances the former being barely discernible, and as a consequence the cocoon being proportionately brittle, thus, for example, the sarcophagus of *C. serampelina* is of an exceedingly delicate nature, while that of *Cucullia* is of a much firmer texture. The cocoon of *P. trepida* is very tough but not always coated with earth, so also are many of the Prominents, *e.g.*, *chaonia*, *dodonœa*, and *dromedrarius*; and Mr. Hellins observes that with *P. margaritalis* it much resembles these, though of course in miniature. *A. Atropos* makes a great smooth chamber, big enough to hold a large hen's egg. And now, having considered the chrysalides themselves, their modes of attachment, and their cocoons, the next step will be to look for them.

Pupa-hunting may be pursued at seasons when other modes of collecting are slack; it is also a capital auxiliary to "breeding," for the females of many *Bombyces* and *Pseudo-bombyces* not readily obtainable by other methods, may thus be procured, but the chance has to be run of bringing out our perfect treasures at the proper moment.

The best time for pupa-hunting is from the middle of August to the end of October, or an interval corresponding to the lull in collecting the perfect insect, which succeeds the summer season and precedes the appearance of the ivy bloom. At this period of the year may be met with, in favoured localities, great numbers of pupæ, chiefly of common species, such as *Pieridæ*, *O. antiqua*, *C. neustria*, *T. stabilis*, *cruda*, *gothica*, *M. brassicæ* and *persicariæ*, *A. grossulariata*, *B. hirtaria*, *H. defoliaria*, *C. brumata*, *O. dilutata* and the like, with here and there perhaps something worthier the expenditure of time and energy: among the pupæ of the better order may be mentioned *X. conspicillaris*, where it occurs, *A. alni* at alder, *C. occularis* between leaves or under moss, towards the end of August; *C. ridens*, under bark, among rubbish, &c., in September; *D. bicuspis*, on birch trunks in the South, on alder in the North, rarely above two feet from the ground; Notodonta trepida., *dodonœa, and chaonia* at the foot of oaks, and palpina., dictœa., &c., at

poplars and willows or under sods, in September and October; *E. fuscantaria* and *Eup. fraxinata*, under moss on ash trees and *C. serampelina*, in a brittle cocoon, also at ash; and in its fenny haunts the chrysalides of *P. Machaon* abound in September; other months are by no means so productive; in April, *Y. ruberaria* may be met with under loose bark; in June, *Œ. quadra* on pales near lichen-covered trees, *M. abjecta* under stones, clods, &c., *B. abietaria* at the foot of fir trees; and in July, *A. Iris* suspended from sallow or neighbouring objects, the *Pterophori* attached to the stems and leaves of their food-plants, &c.

The localities which are most productive of pupæ, are open spots with trees few and far between; our coasts, sand-hills, heaths, parks, fields, clearings in fir or other woods, lanes, and borders of streams, are the most likely places to select from, and the nature of the soil should be taken into account, clay being the most unfavourable, while gravel, chalk, limestone with a thin layer of superimposed earth, greensand, sand, light loamy soil, maiden mould, leaf mould, and the material formed from the dead spicular foliage of fir trees, afford us the best chances of success.

The situations in which pupæ occur are from the topmost twig of the stateliest tree down to some half-dozen inches beneath the surface of the earth, and even under water. We will begin at the top and work downwards: firstly then

The leaves of trees are often spun together, and sometimes attached by a few threads to twigs in their vicinity by larvæ when preparing for their succeeding transformation, thus *Clostera*, *Drepana*, *Ciliæ*, *Stauropus*, *Cymatophora*, *Abraxas*, and *Pericallia* are examples of the kind; now it follows, that if any stray gauzy silk should connect the leaves so spun together with adjoining twigs, these same leaves will, as a matter of probability, be the last to fall in autumn; again, as all the leaves do not drop simultaneously, the betting against two falling at the same time will be about three to two, consequently, if we visit localities known to produce the above species or others with similar tendencies at "the fall of the leaf," we may, by an examination of the little agglomerations remaining among the twigs, possess ourselves of the desired prizes. In my garden here last autumn a lime tree was smothered with small clusters of dead leaves, each of which contained a pupa of *Orgyia antiqua*. But even these will yield to the elements in time, and then the only chance of discovering them will be among the heaps of other fallen foliage.

The twigs and branches are not unfrequently favoured by the pupæ of

certain species, the more generally chosen situation being between the forks, and underneath the larger branches, as with *Porthesia*, *Hemerophila*, *Nola*, &c.

The trunks of trees are tenanted in several ways. Outside, in the nooks and chinks, with the webs and cocoons of Bombyces artfully assimilated to the nature of the bark; from the light gauzy web of *Psilura* on oak to the stony hard cases of the *Dicranuridæ*, all so comparatively easy of detection *after* the escape of the moth, but difficult—in some cases very difficult—to find *before* that occurence. Then,

Loose bark wherever it occurs is very apt to harbour its Lepidopterous tenants; for the proper working of this a lever resembling that used by Coleopterists—a kind of chisel of steel bifurcated at the tip, and at about two inches from this a sharp bend to act as a fulcrum—will be found very serviceable; *D.vinula*, *Diloba*, *A. megacephala*, *Catocala*, *Mania*, *Ypsipetes*, and others, like to spin up in such situations: Then again,

Under the moss on tree trunks the pupæ of many species may be met with; *Lithosidæ*, *Pœcilocompa*, *Spilosoma*, *Acronycta*, *Cymatophora* (sometimes), *Hadena*, *Orthosia*, *Abrostola*, *Catocala*, *Epione*, *Ennomos*, *Crocallis*, *Eurymene*, *Tephrosia*, &c., are all fond of choosing a snug mossy retreat; and, lastly—

The bark and the wood itself are the abodes, the one of certain *Sesiæ*, *Tortrices*, *Ephestia pinquedinella*, &c., the latter of *Cossus*, *Zenzera* and a few of the other *Sesiæ*. These pupæ of internal feeders are not a very satisfactory class to work at as a rule. Those in the bark are very tender, and liable to injury either in extraction or by subsequent drying up of their surroundings; but we shall find that they are very apt to occur in stumps of trees which have been felled, and by noticing the little caps which conceal *S. culiciformis* in birch stumps, we may make sure of their presence, and, by the aid of a saw, possess ourselves of a log or two, and perhaps a goodly store of chrysalides. Again, when to our knowledge *S. apiformis*, *bembeciformis*, *sphegiformis*, *myopiformis*, *formiciformis*, *tipuliformis*, or *Zenzera æsculi* (the males of the last-named will inhabit remarkably small twigs) are within a root, branch, or twig, the latter may be cut or sawn off above and below the seat of the contained pupa (I remember once to have seen a quantity of pupæ of *S. apiformis* thus collected, and the sight reminded me forcibly of the sticks used at fairs and races in the national and aristocratic game of "*three sticks a penny*"—that is, except as to price—and when the dealer in whose possession they were informed me that the pupæ were "in the hole upon his soul," I felt compelled to "try my luck"). In the case of whole trees affected with rare clear-wings, they may be *cut* down and transported, but the drawbacks are *too obvious to mention*.

Having discussed the outsides and in of trees and bushes, the next subject will be—

Herbage. In the first place the pupæ of internal feeders may be disposed of. The common thrift (*Statice armeria*), where it occurs, should be looked to for the precious canker-worm (*S. philanthiformis*), at its heart; pupæ domiciled in stems must be tracked and treated as proposed under "Caterpillar State," but as *otium cum dig.* (particularly when the maximum success can be secured with the minimum amount of drudgery) is the order of the day, it is a wrinkle to be acquainted with the fact, that by following the reed-cutters many pupæ of fen insects may be obtained at little cost and trouble, and if we can manage to get access to the stacks, we can revel in pupæ-hunting of the very cleanest description, and may even run the chance of stumbling on the rare *Meliana flammea*, at any rate, by looking out for the capped extremities of the reeds (for larvæ, enclosed at the time of cutting, soon take measures to exclude the unwelcome atmosphere), many pupæ, such as of *Chilo*, *Senta*, &c., may be collected. "Low plants" have also their external pupal tenants; various species of Butterflies, *Anthrocerœ*, *Pterophori*, Bombyces, &c., are to be found upon them, some presenting striking appearances already mentioned. *Machaon*, on twigs of *umbelliferæ*; some of the *Vanessæ*, *Limenitis*, *Melitœa*, some of the *Hipparchiæ*, *Odonestis*, *Gastropacha*, *Saturnia*, &c., are in this way to be met with.

Getting lower in the scale, the verdure of the ground should be turned over like leaves in a ledger, rubbish and fallen leaves examined, stones, logs, and clods subjected to careful scrutiny, &c., &c.

Out-houses, stacks of all descriptions, should be poked about and investigated, thatch inspected, old beehives seen to, ledges, copings, and other overhanging structures peered under, posts, palings—especially such as are rotten, defective, or lichen covered—old walls surveyed for the artfully concealed pupa of *Bryophila*, and all places, conceivable as likely, ransacked for pupæ.

Stubbing up roots is by no means an unprofitable method of hunting; those mentioned under "Caterpillar State" will prove the most remunerative; and here again, by following the broom-makers, as they pull the ling and broom, our continental neighbours are enabled to save themselves much unnecessary labour—*H. pisi*, *thalassina*, and the various heather-feeding species, are thus to be procured. In some seasons plenty of Death's heads are to be picked up of the potato-diggers for a mere song.

Raking, by means of a blunt 3-toothed rake, is a good method of *working sand-hills*, and is frequently productive of an abundance of *Dianthœcia carpophaga*, *Agrotis cursoria*, *ripæ*, *præcox*, and the like.

Fir woods require a style of working not, I believe, so generally known as it should be. In the more open spaces, and near the borders of pine forests, we may commence operations by getting to the depth of the last season's deposit of leaf-mould, and then, by dividing the layer from that of the previous year, and turning it over, we shall expose such cocoons, or naked pupæ, as may be there. This layer, which is usually from one and a-half to two inches in thickness, is easily separated, and many square yards may be laid bare and examined with ease in a comparatively short space of time. It must be remarked, however, that pupæ will rarely be found within two feet of a tree: the best way, therefore, is to begin to work at that distance from the trunk. By this mode of collecting, *T. piniperda* is, in favourite localities, to be procured in large numbers, together with a sprinkling of such species as *F. piniaria*, *E. fasciaria*, and *M. liturata*.

Pupa digging is a method which has been strenuously advocated in this country; the implement most generally recommended here is a common garden trowel, but the French prefer a broad chisel, and our Lancashire friends use a three-pronged fork: the latter has the disadvantage of exerting unequal pressure when employed in levering up a sod; the curled-up sides of the garden trowel are rather objectionable—the tool should be made nearly flat, and of course the material should be steel, not iron, that is; for those who prefer the trowel to the chisel.

The Rev. Joseph Greene, who has had great experience as a pupa-digger, and whose well-known essay on the subject has been a theme of admiration amongst an appreciating circle of friends, points out that "parks and meadows with *scattered* timber trees" are the best localities, and that "those trees from which the surrounding grass has been worn "away by the feet of cattle, and those situated on the borders or banks "of streams, dykes, &c., when the soil is dry and friable, will be found "most remunerative." The *modus operandi* he describes as follows:— "If there be a nice dry sod ensconced in some snug corner formed by "the roots, he can scarcely fail of success. Insert the trowel, *in this* "*instance*, about eight inches from the trunk, to the depth of four. "Turn up the sod and lay it on the ground. Look then at that part "of the trunk from which the sod has been removed, and if you cannot "see, feel gently with the hand for any cocoons which may adhere. "Then take the sod in the left hand and tap it softly with the trowel, "and the pupæ which form no cocoon, or a very weak one, such as "*aprilina*, *prodromaria*, &c., will drop out. If the sod be composed of "very loose, dry earth, simply shake it. Lastly, tear the roots asunder "*for Bombyces*; if, however, the roots be strongly matted together,

"there is little or no use in doing this." (Zool. 5395). The same gentleman believes the key to successful pupa-digging to be "*Patience.*"

NOTE.—If cattle come too close to the trunk of the tree they do harm; if they leave a ring round it they do good.

On the same authority "poplar, willow, elm, birch, beech, ash, and hawthorn" are stated to be the most remunerative trees.

Before leaving this subject I cannot resist giving an anecdote, the facts related in which occurred to a friend of mine—a well-known entomologist, whose name need not be mentioned—on the occasion of his first attempt at pupa-digging. He had for some time been absorbed in his occupation at the foot of a majestic tree, when he became aware of the presence of an individual of the Bill Sykes persuasion. This party, who had evidently been watching the movements of my friend with anxious interest, broke out, "Yer a bit out, *you* are—it was t'other end o' the field that the Spider stowed the swag, but yer won't find it, 'cos the wedge is in the pot by this. *Somebody's* bin an' blowed, for bless *me* if *you* was at the crack: who's blowed?" The relief of my friend when he got out of his dilemma may be better imagined than described, and he has not again, to my knowledge, gone pupa-digging.

Dragging with a water-net will have to be employed if we desire to acquire the pupæ of the *Hydrocampidæ* and *Acentropus*; we shall have to drag in such water-plants as water lily, duckweed, *Callitriche*, *Stratiotes*, and *Potamogeton*, and examine them on the shore for the small silken cocoons of *Paraponyx* and *Acentropus*, and the quaint pupæ of *Cataclysta* and *Hydrocampa* enclosed in the old case of the larva.

Management.

To remove pupæ of Butterflies, &c., found on walls, under copings, and elsewhere, is not an easy job. Our endeavour must be to chip off the part of the substance to which they are attached without injuring them; nor is the cutting out of such cocoons as those of *Dicranuridæ* without its difficulty. These, by the way, should be extracted entire, and by no means opened, otherwise the future imago will lose its natural leverage, and most likely be crippled; for it must be recollected that when the time for emergence arrives, the insect is provided with a wonderful fluid for softening the structure which encloses it.

When chrysalides are fixed to leaves or twigs, we should try to *cut off Λ-like portions*, which will enable us to hook them upon a line of

string; dead leaves, rubbish, &c., enclosing pupæ should be disturbed as little as possible; stems, &c., bearing *P. Machaon*, *Anthrocerœ*, *Odonestis*, and the like, have only to be plucked or cut off below the seat of the pupæ. The above kinds may be kept in gauze-covered band-boxes (across which a few strings have been stretched for the convenience of suspending some of them) in an outhouse, care being taken to exclude mice and other vermin.

Subterranean pupæ will require a different mode of treatment. When first secured they should, with as much of the cocoon as we can manage to save entire, be conveyed between layers of moss, or anything which will steady them and keep off pressure; then, on reaching home, they should be carefully deposited on, and covered over with, one of the soils mentioned at page 31, in some vessel of unglazed pottery-ware, a thin layer of cocoa-nut refuse being placed over all to preserve a sufficient amount of moisture, and at the same assist in preventing mouldiness. Some collectors, however, prefer moss for the purpose, in which case it should be prepared previously to using by dipping in boiling water, to destroy any tenants; baking and re-damping is sometimes resorted to for the purpose, but the moss is thereby rendered too friable. Some consider it necessary or desirable to place their pupæ on end, head uppermost, in the soil, in order that the perfect insect may emerge in the best position for making its exit, but this is not the posture most usual with pupæ found in Nature, though true it is that while the bulk lie horizontally, back uppermost, the *Vanessæ* and some internal stem-feeding species, by way of example, are placed head downwards, others tail end down.

Damping pupæ, I have long been satisfied, is, as a rule, a great mistake. It is well known that caterpillars such as enter the earth to effect their metamorphosis seek such corners and aspects as will protect them from the baking rays of the sun or the drenching showers which usually come from the S.W.; they prefer the sides of trees and other objects which face the North, and we should therefore keep our chrysalides rather cool and dry than otherwise. But the great difficulty of damping is this: in Nature the cocoon keeps the wet from actually touching the pupa, but when we have broken the case we cannot replace it; we cover up the chrysalis with something that touches it all round, and then the wet hangs on it and does harm, otherwise dampness is necessary for many species to emerge in good order. Those which spin up above ground have generally a covering which acts as a para-sol in sunshine, a para-*pluit in rain*, while the naked chrysalides of Butterflies are usually

in the shade of some leaf or ledge; and *Machaon*, I suppose, gets as much heat as well as moisture in his fenny haunts that the one renders innocuous the effects of the other; but I shall shortly have to refer more particularly to this under "forcing." Stems containing pupæ ought to be stuck in damp sand, for, should they dry up, there will be great danger of the contents being injured from the contraction which takes place.

Aquatic pupæ must, of course, be kept in water in globes similar to those used for gold-fish, but covered over with gauze.

Forcing is a process which, in the case of certain species, is invaluable to the collector. There are many species the pupæ of which it will be found almost impossible to preserve alive until the normal time of appearance of the perfect insect: of these, especially the thin-skinned Sphinges, such as *Chærocampa* and *Deilephila*, may be mentioned.

The principle on which forcing is founded consists in the circumstance that though these pupæ are readily killed by cold with moisture as well as by dry heat, they are enabled to bear a considerable amount of heat and moisture together. This would seem to indicate that they originally inhabited a warm, moist climate, and may throw light on the appearance, at long intervals, of certain species in hot seasons. However that may be, it is indubitable that in the case of *D. galii* nearly every pupa can, by the treatment, be made to yield forth its perfect Sphinx, while without it failure is almost inevitable.

The plan is as follows:—Procure the saucer of a flower-pot, of the size required according to the number of subjects to be operated on, strew the bottom with a layer of gravel, and over this place some moss, again put gravel, followed by moss; on the latter let the pupæ be arranged, and then well covered over with a thicker layer of moss. Next take a piece of cane, bend it into the form of a circle in size a little less than the saucer, and secure it in this figure by the aid of twine; in the next place, take two other pieces of cane, each of about two-thirds the length of that which forms the circle, and having fixed them by twine so that they cross one another at right angles, bend them into semi-circular shapes and fasten the four ends to the circumference of the circular piece, then on to the framework thus formed bind moss by means of thread, and place the concern lightly with its circular base on the moss in the saucer. N.B.—The object of this contrivance is, that on *emergence the insect* may be able at once to crawl to a place suitable for *drying its wings; the* whole may then be freely damped, and covered

over with a suitable sized bell glass, to the knob of which a sheet of stiff paper has been attached, to act as a screen against the direct rays of heat; and the whole apparatus, with its contents, may now be placed in the fender in front of a good fire. Free and frequent damping with tepid water is necessary, for should dryness be permitted to exist, the result will be a failure. There is no need to keep the fire alight by night. In from ten days to a fortnight the moths will begin to make their appearance. About Christmas is the best season for forcing. I am aware that there are other methods of forcing, but, as the one recommended above is that by which my friend, Mr. Boswell Syme, has succeeded in bringing out *all*—I believe without exception—the *Galii* which he has at various times had the good fortune to meet with in the larval state, on the Deal Sand-hills, it would be simply waste of space to mention them.

Pupæ in our breeding-cages should of course be left as much *in sitâ* as possible. The chief thing is to keep out the larvæ of that pest, *pseudospretella*; and sometimes it may be necessary just to examine, and perhaps gently to stir the earth in the cages, to see if they are at work.

P. O.—Pupæ are best transmitted in boxes, packed in soft moss, or bran—small ones may be sent between two layers of wool—but the journey, even in a first class padded carriage, is not calculated to add to their vitality.

Observation.

The student will find but little to observe in the way of movements of pupæ beyond those already noticed at the commencement of a previous chapter. Many of the forms are worth study, and are suggestive of grouping species, for, as with the eggs, a similarity of structure is noticeable between the pupæ of allied species, though here and there we meet with a puzzling exception: for example, who could suspect, without previous instruction or experience, that the chrysalides of the little Plume-moths would be fixed in their positions like those of some of our Butterflies, or that *Ephyra* and *Rivula* would similarly mimic the mode of pupation of other Butterflies?

In describing it should be noted—

Is the pupa unattached or attached, and if so, how attached?

Is it naked or furnished with a cocoon, or the rudiments of one; *if the latter*, describe it?

How is the skin of the larva shed from the chrysalis?

What is the length of the newly-transformed pupa?
What is its proportionate bulk?
Describe its form,
„ its structure,
„ its tints and markings.
In what manner does it vary?
Does it resemble or differ from its congeners, if so, in what way?
Do any changes afterwards take place in form, structure, markings, colouring, &c.?
At what time is the pupa state assumed?
How long does it continue?
What movements is it capable of making?
How does the male pupa differ from the female?

Preservation.

In the case of the chrysalis this is a very simple matter. They may be killed by plunging into boiling water, or the puparium, after the escape of the perfect insect, may be neatly gummed together to the shape it possessed prior to that occurrence. Some, after death, lose their polish, which may be imitated by varnishing, if thought desirable. It is always advisable, in such as are naturally attached like the butterfly chrysalides, to secure the leaf, or whatever it may be, to which they are fixed, for this will give the specimen a natural appearance. The cocoons, &c., where practicable, should be preserved, to give an idea as to the appearance in Nature.

But these cocoons, pupæ, &c., should be kept in a collection separate from the perfect insect, because, for one thing, the danger of their getting loose, rolling about, and doing damage is considerable; and, for another, they interfere with the symmetry of the arrangement.

END OF CHRYSALIS STATE.

THE PERFECT STATE.

Collecting.

"Eager he looks; and soon to glad his eyes,
"From the sweet bower by nature formed, arise
"Bright troops of virgin moths and fresh born butterflies;
"Who broke that morning from their half-year's sleep,
"To fly o'er flowers where they were wont to creep."—CRABBE.

From childhood to green old age few pastimes are more healthily *exciting than* "*the chase*" of the perfect insect. The bare notion of

"a gilded butterfly," radiant with beauty and grace, awakens a train of thought associated with joyous days of country life. But we must cast aside for a while such sentiments and descend to matter of fact.

The apparatus required for collecting the perfect insect consists of, in the first place—

Nets: of these we will first consider the *frames*. That now most commonly in use is a light ring net, the steel ring being jointed for the convenience of folding up into a small space; the handle of this implement is sometimes made on the sliding principle of a telescope.

The umbrella net (so called from its appearance when folded up) may be of exceedingly light construction, the ring being formed of self-acting side pieces of stiff "jack spring." It is a favourite with many: its advantages are that it is lighter, stronger, generally more capacious, more quickly brought into use. The disadvantages are that the stick which bisects the circle of the ring may strike some insect we are about to capture; but then this need be no thicker than a cane, and is consequently less than one-third the superficies of the circumference of a cane ring net. The real thing against it is the mortification of hearing some urchin remark, "Look at that fool! why don't he put his umbrella up in the pelting rain!"

The cane net, made with a tubular T or Y-piece, into the arms of which the ends of a yard and a-half of cane (or whalebone) are inserted, the other aperture being fitted with a handle for which a walking stick is generally used.

The "30-foot handle net," supposed to be necessary for working *Apatura Iris*. As a substitute, a 20-foot mountain-ash pole may be cut from a dense copse, and an ordinary net tied on to it. By this contrivance, Mr. BARRETT and a lady entomologist, managed to catch all they could get sight of last summer—about sixteen in number.

The clap-net which seems to have quite gone out of fashion; and others, special ones, which will be mentioned in their places.

The material of which the bag of the net is composed varies according to taste. Lino and book muslin are generally used; the former being green, the latter white. Silk gauze (green) is often used, but its tendency to fray is much against it. The best materials are *Crêpe lisse* and *grenadine*, both silken fabrics of a durable and transparent description, which, though rather expensive, possess very superior qualities. Again, for night work, black is much to be preferred to green or white, as insects when caught, can be more readily distinguished; and white is certainly preferable to green for day work, not only for a similar reason, but because

most people are aware that the common green dyes rot the textures to which they have been applied; and, as a consequence, green lino nets come to grief with the slighest rough usuage. The only drawback to white is, that it attracts the attention of the million, and betrays your whereabouts; and this reminds me that if you are of a solitary, retiring disposition, and prefer to keep your own pet locality to yourself, it is advisable that you should attire yourself in rifle green or some such mournful tint, and above all, shun the use of a shiny cap, brass fittings, and such glittering articles as may be seen for miles even by the naked eye; after which your actions are very likely to be curiously followed by the aid of a field glass, without which, an amateur detective desirous of ferreting out the secret haunts of a sly collector would as soon think of starting on his expedition, as a sportsman of leaving his gun at home on the first of September.

NOTE.—A little practice will enable us to tell whether the insect netted is the right one or not, for probably it has some peculiar way of spreading out, or closing up, its wings in the net—shamming death, vivaciously struggling for liberty, or settling quietly on the sides.

The make of the bag of a net is worth consideration. In ordinary cases, as in the umbrella kind, the distance from the mouth to the bottom should be rather less than the length of the collector's arm, and it is a good plan to let in a circular bottom piece in the manner of the crown of my grandmother's cap. The seams should be outside. The net should be christened the first wet evening to take out the "dressing." With small ring nets, the bag need not be so deep; they should be made of a tapering shape, which will enable the collector, by grasping it in the middle, to at once preclude egress to any captured insect. The ring to which the bag is attached should be covered with thin leather.

Boxes. First a collecting box containing a stock of suitable pins. It should be made of zinc (which is not apt to corrode like blocked-tin) in order that the cork may be damped; a precaution very necessary in hot seasons. Next a few glass-topped "purple-shouldered" boxes for the reception of such insects as, being in doubt about them at the time of capture, we may wish to identify on the spot; and lastly, a goodly store of pill and chip boxes of various sizes, prepared as recommended at page 12, these should be punctured in the centre of the bottom in three or four places, either with a darning needle or the point of the blade of a penknife.

Killing apparatus, or, at any rate, something to stupify our *captures on the field,* will also be required. Of these, the choice of one *or more of the following* may be made.

A cyanide bottle. This is rigged up as follows:—take a wide-mouthed bottle having a capacity for from three to six ounces, strew a layer of cyanide of potassium (a deadly poison, by the way) on the bottom, and over this sufficient plaster of Paris, mixed with water to the consistence of thick cream, to cover the cyanide; when this is set, a few thicknesses of blotting paper should form another layer; and an air-tight cover (which is more handy than a stopper) should close the mouth. Such a bottle may be charged by any druggist at a trifling expense, and will last for months, provided that it be kept cool and the air excluded. When the poison begins to lose power, its effect may be greatly increased by warming the bottle with the hand or otherwise, but it is then time to have the bottle replenished. Another way is to put alternate layers of cyanide and blotting-paper. NOTE.—The destructive power is much increased by the addition of Tartaric acid, which, by decomposing the deadly salt, causes the evolution of hydrocyanic acid.

A chloroform bottle. That most recommended is constructed of brass, the only exit for the chloroform being through a finely perforated nipple which screws in; and this again is capped over with a top which fits by screwing accurately on to the aperture of the nipple. The latter permits a very small drop to flow at a time; or, if any surface be touched with it, the fluid runs very slowly out; thus we can run a drop over the punctures in the chip box previously referred to, and clapping our finger over it, the vapour speedily enters and does its work.

A laurel tin is used by some for the purpose, but unless the bruised leaves be very fresh, their action is scarcely speedy enough for field work.

The subject of stupifying and killing is more fully entered into under "management."

A satchel is a better receptable for our apparatus than the pockets of a coat, for the reasons that the danger of crushing is avoided, our burden can be whipped off at any moment that great freedom of action is required, our treasures may be carried like a carpet bag in the hand, to that shaking is much diminished, and, above all, greater coolness is ensured, for the heat of our body on a hot day is not likely to conduce to the peace and quietness of our captures; for the latter reason the material should be pale in colour; and if it be furnished with a couple of rings to be used for either a handle or shoulder strap (with swivels at each end, like, but larger than, those on our watch guards which can be instantly attached or detached) so much the better.

Mothing is a term used to express catching with a net moths *upon the wing.* At first one might be apt to think that this consisted

merely in chasing every insect seen and endeavouring to net it; but a large amount of trouble may be saved and a far greater number of captures secured by a little foreknowledge.

The grand secret of successful collecting, whether by day, dusk, dark, or dawn, lies in one little word—**WHY?** If the beginner, instead of clinging persistently to the delusion that the more ground he gets over the better will be the sport, would just ask himself, "Why here?" whenever he captures a decent insect, and would insist on a satisfactory reply or else a give-it-up from his inner man before leaving the spot, we should soon have a race of real insect hunters. I fancy I hear some one say, "Why any fool knows that!" Exactly so; and "any fool" will doubtless keep up his character for stupidity, by blundering on and neglecting to act on it.

Where there is one there are more is true in a general sense; hence the greater reason why the above interrogatory should be answered on the spot. "Why?", here, asks a string of questions. Whence from?—Whither bound?—Was it a female on the mission of ovipositing?—a male in quest of a virgin female?—fluttering about its food plant?—on its way to some neighbouring attraction?—on the wing for pleasure, enjoying the hot sunshine, the cool shade, or some other congenial atmospheric condition?—its proper time of flight?—seeking a place of rest?—*or* was it disturbed, and in its fright flew it knew not where?—was it blown by the wind against its will?—under the influence of light?—or after somebody's sugar?

Prospecting is an important measure; on visiting a locality we should carefully survey it in order to form an estimate of its probable capabilities; the flora of the neighbourhood, the character of the timber, the soil, aspect, shelter, temperature, moisture, &c., should be ascertained.

Woods, when situated inland, are profitable hunting grounds, especially if not too dense. The open parts, as the rides and clearings where the trees have been felled and the underwood is of only two or three years' growth, are the best spots; outside, the border on the lee side is the most productive; the same applies to pine forests.

Parks, when timbered with majestic trees, and particularly when there are plantations enclosed in ring fences, are very desirable places of resort.

***Heaths* and *Moors*; during windy weather the sheltered hollows, *usually yield most insects*; at other times the exposed positions pay best.**

Lanes. Here the hedges should not be too high or too dense, and due regard must be had to the direction of the wind at the time of working.

Fens. The more extensive, the more profitable as a rule; open parts bordered by plenty of reeds, bull-rushes, &c., should be chosen. This class of locality may be worked by sugar and by light, as well as by mothing at dusk and dawn and searching after dark.

Ponds, borders of streams, &c., when there is plenty of vegetation at the edges, and aquatic plants on and under the water, are most suitable.

Sea-side localities should be worked as near the coast as possible; undercliffs and sandhills will prove most remunerative. In the former, a good variety of low herbs on broken ground without trees or woods (for these are very unproductive near the coast) are good signs.

Sand hills should be pretty barren, for then the insects will be found thickly congregated in the little oases of the desert.

Chalk pits, gravel pits, and similar places, are admirably adapted for collecting; the parts which have not been meddled with for some time are the best.

Downs and mountain sides with short herbage of a varied nature, especially those in which wild thyme predominates, and which have an aspect sheltered from the wind, will be found good.

Waste places overgrown with rank herbage, thistles, ragwort, and such like, sometimes teem with moths, generally speaking (but not always), however, the class of insects met with are of a common order.

Banks covered with rank weeds, usually produce plenty of common things. When the herbage is of a more refined and scant nature, the sport will be proportionate; in such places we sometimes meet with hymenopterous nests infested by parasitic moths which may be caught on the wing hard by in the evening.

The time of year to start after collecting any given species is usually determined by a reference to the dates given in Stainton's "Manual," or else by notes in our diaries, but it by no means follows that, because we capture an insect on the 1st of April, the 4th of July, or *the 5th of November*, in one year, we shall find it on that particular day

in the next; an allowance must be made for forwardness or backwardness of the season, as the case may be, the state of the weather must also be taken into account, and, also, the latitude in which the insect is sought, for the further north we go the later (*ceteris paribus*) it will occur. Sometimes a prevailing east wind will delay the appearance of a species for weeks—a curious exemplification of this occurred to me several years ago—I had brought indoors a large number of pupæ of *Clostera anachoreta* for the purpose of forcing, in order that I might get the job of setting them out over in the slackest time of the year; the chocolate-tips began to emerge freely about Christmas, when, all at once, an east wind set in, and, as suddenly, the moths ceased to show up; as soon as the wind shifted, however, out they came again as thickly as before. The cause of the phenomenon was evident, for the pupæ were kept just as warm as ever on the mantel-piece.

Another way of hitting on the time for the appearance of a species is more practical; it consists in noting and associating in the mind with it some other occurrence; by way of illustration as to my meaning, let us say the white thorn is beginning to show its little reddish buds—it is time to look for *H. rupicapraria*; the black thorn is beginning to blossom—now for *L. polycommata*; and so on with other buds and blossoms. Again, *Biston hirtaria* has been out a week in our London squares—*Aleucis pictaria* ought to be appearing at Dartford or Chigwell Row.

The times of day or night at which insects fly also demand special notice, and here, too, if we arbitrarily insist that such-and-such an insect is sure to be on the wing at some particular hour or minute, we may go astray; for example, it is better to say—*S. chrysidiformis*, or *M. fuciformis* takes wing in the morning, that when the sun becomes more vertical, and the heat becomes too intense for it, it retires, and again appears in the afternoon, than to fix the hours of flight at from 9 to 11 a.m., and 3 to 4 p.m.:—or, that the best time for the majority of *Tortrices* is a couple of hours before dusk, than that they fly at 6.30 p.m.:—or, that the *Nonagriæ*, *Tapinostola* and *M. arcuosa* settle down on their food when, after dusk, their short flight of twenty minutes or half-an-hour is over, than to put down the time at 8.30 sharp; similarly, that the "Waves" start forth as dusk is coming on—that night-flying *Noctuæ* leave their hiding places sooner or later after dusk—that butterflies delight in bright sunshine—that *Sesiæ* like the sun, but are of opinion that they may have too much of a good thing.

***Another thing* to be remembered** is that, if an insect

be on the wing an hour before dusk it will, under favourable circumstances, be so again at an hour *after* day-break, or, if it fly an hour after dusk—an hour *before* dawn; for the amount of light is then about the same, and light has more to do with the matter than is generally supposed. Under extraordinary occurrences, such as eclipses (when even chanticleer crows out of time), night-flying moths will come forth in the middle of the day—but the more familiar examples with us are, that on dull sunless days butterflies make themselves up for sleep, just as *Noctuæ* do on bright moonlight nights, for I cannot subscribe to the theory that the latter are attracted by the light of our satellite and flock to it in such numbers as to account for the spots thereon.

Watching the trees in an open glade of beeches or oaks, we may notice the gambols of the Hook-tips as they flit about quite out of our reach; but every now and then one will descend, and may then be captured. This, by day, is applicable to many species, dozens of which may thus be taken. *L. rubricollis* sometimes swarms round young oaks, *Brephos* round sallows, *F. piniaria* round firs.—In the early morning sunshine, too, it is a profitable method of working, and towards dusk, by stationing ourselves under oaks or other trees, troops of dancing little moths will be seen, and by the aid of a longish handled net, we may thus supply ourselves and friends with *Eup. dodoneata*, some of the *Phycidæ*, several *Tortrices*—it was in this manner the indefatigable Mr. Meek obtained the hitherto rare *S. deflexana*—one thing, though, this sport only lasts for a quarter of an hour or so, but during this short space of time much may be done.

In working hedges, rides of woods, and similar situations, a great deal more is to be effected by taking up a position which experience has shown us to be good and then quietly biding our time, than by rushing about in a state of frenzy and striking hap-hazard, and we must also recollect that the colour of the insect for which we may be specially looking makes a difference in the matter; thus, if the insect be white or pale we should endeavour to so place ourselves that its form and size may stand boldly out against a dark mass of foliage; if, on the other hand, it be green, brown, grey, or sombre in its tints, then we must take the sky for our back-ground.

Bloom, or patches of flowers, whether in a wild or cultivated state, are best worked by standing perfectly still at the particular flower-bed or patch of bloom which we have found, or which we should judge to be most attractive, and then, whether it be *M. fuciformis* at *Ajuga*, *C. porcellus* at *Rhododendron*, *T. convolvuli* at *Petunia*, D. lineata at a bed of scarlet

Pelargonium, *Dianthœcia* at *Catch-fly*, *Plusia* at Turn-cap lily, or anything else at any of the numerous alluring flowers, they will not be afraid to come within easy reach.

Lying down on the ground in suitable localities many moths become evident which, in our erect position, had been invisible—little *Psyche radiella* is a striking instance of this. By squatting down, and so lowering the level of our sight, we may often bring into the field of vision insects which otherwise would have remained unnoticed.

A wide range of vision, most useful in working banks, may be acquired with a little practice; the way is to look intently at a spot some six yards in advance, when, after a time, you will become aware of any object stirring within a space of, say, forty square yards; this is the method of working for *S. chrysidiformis* in the perfect state, which, unless frightened, booms along like a Burnet, but, being of small size, easily escapes notice until the eye becomes familiar with it; and this reminds me that by experience it is no difficult matter to detect species on the wing, thereby saving considerable time and trouble by not catching and letting out again those "not wanted."

The altitudes at which insects fly vary from that assumed by the Purple Emperor down to *Psyche radiella*, which keeps within a foot of the ground, and *Acentropus niveus*, which skims almost on the surface of the water. *C. bajularia* flies at dusk at a height of about ten or twelve feet from the ground, other species even higher, but the majority flit within reach of an ordinary net. We must not, therefore, content ourselves with merely looking straight before our noses.

Boxing requires a word or two. It has already been shown how simple it is with a little practice to manipulate the box with one hand, but what here demands attention is boxing from the net. When we have netted an insect we should observe whether its tendency is to fly up or down, and hold our net accordingly; or throw the jelly-bag part of the net over the ring to make certain and then get the hand in cautiously, holding the handle of the net between the knees, or let it lie on the ground, and then we should place a box of suitable size over the fly with the right hand, and quickly grasp the box outside, together with the net that covers it in the left hand, then, with the right at liberty, we may rapidly place on the lid with a tilting movement, enclosing, if necessary, *a small portion of the net*, which may be gently withdrawn before quite *shutting the lid*; the box and contents may then be transferred to our

satchel, taking care not to mix it with our empties, otherwise many captives will be let out again, and remembering that each individual should be accommodated with a separate travelling compartment. But if it be desirable to kill the insect on the spot the cyanide bottle may be used instead of the box, or, after putting the box over the insect we may touch the net over it with chloroform and then put the lid on over the network, or cover over for a few seconds with the palm of the hand; when the insect is stupified it should be turned out, pinned, pricked with oxalic acid, and transferred to the pinning box. The collector will take note that while many species travel safely in the boxes, thereby saving us much time, others will inevitably destroy their plumage if so covered. All the Butterflies, with the exception of *Leucophasia sinapis*, are perfectly quiet when boxed, but the larger ones take up too much space, and are better stupified, killed, and pinned on the spot; they should not be disfigured by pinching, which is a barbarous process.

Most day-flying species are at once quiet when placed in the dark interior. The Hawk moths, as a rule, should be killed on the spot, but the sun-loving *Sesiæ* travel well enough; Bombyces and Pseudo-bombyces should never be carried about alive. Of night-flying *Noctuæ* and *Geometræ*, the great majority may be safely transferred in their boxes to our satchel, with certain exceptions, as, for example, *Cymatophora*, *Thyatira*, *Catocala*, *Uropteryx*.

NOTE.—It is best, after collecting at Sugar, Sallow, or Ivy, to leave such moths as do not knock about alive till the next morning, as they then empty themselves and preserve much better, for, a moth killed with its body full of sugar or honey is apt to become an object after a time. Sugar will sometimes exude from a prick in the body of *G. vaccinii* after it has been set two or three years, but it soon soaks through and spoils *X. rhizolitha* and some others (the unique *Noctua flammatra* in Mr. Bond's cabinet is full of sugar). Another way is to chloroform and pin them when one gets home and kill them the next day. When pinned in our boxes the wings should not be allowed to stick up, but ought to be kept down by cross pins, for if the specimen get at all set it will be pretty certain to spring after being removed from the saddle.

Attractions for moths and butterflies.—Before proceeding further, it will be as well to enumerate the predilections of the perfect insects. These centres of attraction may be classified as natural and artificial.

The *virgin* female, of course, holds the first place, and as, in *the case of insects*, she does not seek, but rather is sought by, the male,

she ought, during her life, to attract at least one of the opposite sex. The case of *Orgyia antiqua* is too well known even to the non-entomological. A web with a contained chrysalis is secured for the purpose of seeing what it will come to, and is perhaps placed in a window-sill: one day a supposed spider makes its exit, much to the disgust of the captor, who had previously hoped he should be gratified by the appearance of a *real* moth; but what puzzles him most is that a whole lot of little brown things, with a white spot on either fore-wing, and with feathery antennæ, should be "all about the place," some of them apparently so "tame" that (likely enough the investigator begins to get alarmed at the phenomenon) they decline to skedaddle before the approach of even stately man. The noble "Kentish glory," "The Emperor," and "oak eggar" are likewise most pertinacious in their pursuit of a bred female; and a friend of mine used to remark to those who for the first time saw "the glories" coming up against the wind, "We feed 'em well here, you see,"—a bit of chaff, that.

Most other female *Bombyces* are very attractive in their way; the Swifts, the *Liparidæ*, *Lasiocampa*, *Limocodes*, as well as the *Smerinthi*, the Prominents, Hook-tips, several *Geometræ*, the *Psychidæ*, &c., are well known, but probably all moths of the sex are so in some degree, for we notice an indisposition for flight in the unimpregnated female to such an extent that one captured on the wing is pretty sure to be on the errand of ovipositing; with the exception, of course, of such autumnal hybernating species as do not pair till spring.

An attracting cage for the female is readily made by tying three thin strips of cane each in the form of a circle of three or four inches diameter, and then fixing them at right angles to one another, so that they will then give the idea of a rudimentary hollow globe, over which muslin or green lino may be stretched, completing a chamber through which the air can pass. The addition of a fixed twig to the interior, for the moth to hold on by, is an improvement.

The principle is that (the moth being inserted and fastened into this cage) "the scent" will be more readily wafted, than by other means, to distant spots, as it travels in a line corresponding with the direction of the wind. This line, when crossed by a male, is, under favourable circumstances, quickly followed up; for although at first the zigzag deviation from the course is considerable, it gets less and less in proportion to the distance, just as a good dog may for a time be baffled, in his eagerness overshooting the mark, but quickly returning to the scented *track*.

Favourable circumstances are that the weather be propitious for the *of the male*, that the wind be gently but steadily blowing in one

direction, such as West, South-west, or South, and, above all, that the female be "calling," which may be known by her general aspect, her listless, not-inclined-to-move look, a faint tremor of the wings, her abdomen elongated and perhaps curved forwards, with protrusion of the last segment through the furry coat, or rather the down drawn away so as to denude it.

The time of year (as well as the locality) must be chosen so that we may be sure that the perfect males are really to be met with; the time of day will depend much on the species it is intended to attract. Some, such as *Endromis*, *Saturnia*, *Orgyia*, *Drepana*, &c., will fly in the hot sunshine of the morning and afternoon; the *Lasiocampæ* will generally make their appearance at three o'clock in the afternoon, the Swifts at dusk, the bulk of the *Geometræ* soon after dark, the *Noctuæ* later; *O. pudibunda* comes freely about 11 p.m., and, I believe, the Prominents later still; therefore if it be a rarity we desire to entice, it may be worth while to sit up throughout a favourable night to find out the time; after that we may spare ourselves by visiting the scene of operations at the proper moment.

The food-plant of the future larva is the next natural attraction. The perfect insects are rarely found at any great distance from it, and by visiting the localities in which the food-plant occurs, we stand the best chance of securing impregnated female moths.

Flowers of various kinds act as wonderfully alluring baits. Of these, sallow-bloom in spring, and ivy-bloom in the autumn, are the greatest favourites with collectors.

Sallow-bloom.—Having first found a locality of promise, where sallow-bushes are not too numerous (for in that case the insects will be inconveniently widely distributed), nor too tall, for they are then awkward to work, and are best treated by shaking over a sheet:—they should be well covered with the fresh, full bloom of either male or female catkins, for it is a great mistake to suppose the latter unproductive, the collector may set to work cautiously, taking care to disturb the insects as little as possible, on favourable evenings—that is, when the wind is not in the East, though generally speaking wind is not unfavourable unless it be too boisterous. He should be provided with lantern (a bull's-eye is best for the purpose, because it concentrates the light), net, a hooked stick, boxes, and killing apparatus, or, better still, with a stick to the top of which the lantern can be fixed at an angle of about 25°, and a small shallow net some inches below that, at about 20°, the ring of the net being just in advance of the lantern. The object is, that though at first

the sallow visitors are sprightly enough, they soon become more or less intoxicated with the nectar, and frequently fall when the light first glares upon them, so that by the apparatus mentioned the odds are greatly in favour of the net intercepting them. If, however, an insect is seen feasting—perhaps its glistening eyes first attract our attention—it may be gently tapped with the stick into the net below, for they usually fall plump downwards, helplessly tipsy (this is sad, very sad! Could not somebody, with the laudable view of enforcing moth morality, bring in a permissive prohibitory bill to abolish sallow- and ivy-bloom, and shut up demoralizing flowers generally?). The ordinary lantern and net, however, answers the purpose very well, the former being in the left, the latter in the right hand, the bottom of the bag being pulled toward the handle-end of the stick, and held there, so as to keep it out of the way, and also render the net more shallow—for a deep net is not required—in fact a small shallow net specially made for the purpose is best. The captures should then be further stupified, if necessary, with chloroform, pinned, treated with oxalic acid, and stuck in our collecting-box; or they may be transferred for a temporary sojourn in the cyanide bottle at option. When sallows are high and in large bushes, branches cut off before dusk and stuck into the ground in suitable wood-paths, are very attractive and easily examined; but, if this be not done, the easiest and quickest, and consequently the most productive way of working high sallows (and ivy too) is with a hooked stick and inverted large umbrella, tapping or gently shaking each branch of sallow, and *very* gently shaking ivy, over the umbrella, when the moths are sure to fall in. The *gentle* shaking is on the principle of taking care of the goose that lays the golden eggs, for the bloom easily falls off.

A tray for intercepting the fallen moths, suspended round the neck like those worn by the old-fashioned peripetetic fruit-sellers, has been used with success by, I believe, the Messrs. Crotch.

A sheet—the larger the better—prepared by cutting a circular piece out of the middle and slitting it up from one of the sides to the middle aperture, may in suitable localities be adopted; but it is not everywhere that this can be conveniently applied, either the nature of the ground or surrounding bushes interfering. Where applicable it may be drawn round the bush at starting, in which case, having carefully made our search by aid of the lantern, we may proceed to shake with good chances of success.

Such insects as fall may be selected from the sheet:—a good large [illegible]ap net placed on the ground under the part searched is better than [illegible]ag. *En passant* the catkins which drop should be deposited in an [illegible]ide receptacle, and an eye should be kept open for larvæ.

By day, in the sunshine, *Brephos parthenias* and *Adela cuprella* frequent sallow-bloom.

In the evening the whole troop of *Tæniocampæ*, and other spring Noctuæ, such as *T. pinipeda* and *X. lithorhiza*, resort to the sign of "The Catkin," and there convivially hob-nob with their hybernated relatives, *Glœa*, *Scopelosoma*, *Dasycampa*, *Hoporina*, *Cloantha*, *Calocampa*, *Xylina*, and even *Laphygma exigua*, the party being usually augmented by interlopers, as *Amphipyra*, *Agrotis*, *Gonoptera*, and *Peronea*, with a sprinkling of Geometers, *A. badiata*, *H. progemmaria*, *S. illunaria*, and *Eup. abbreviata* being the vernal, *Cidaria psittacata* and *miata*, the hybernated representatives. The most aristocratic visitors are *L. exigua*, *G. erythrocephala*, *D. rubiginea*, *X. conformis*, and no doubt *Zickenii*; but these more properly belong to ivy.

Ivy-bloom may be similarly worked, but the sheet used need not be split. Shaking, too, will assist us more than at the sallows. It may also be necessary to provide ourselves with a light ladder when the ivy is high up. A very large number of species visit this bloom, which is even more stupifying than sallow in its effects on the moth tribe.

At ivy may be met with all those *Orthosidæ* which appear in autumn. These will, of course, now be in their prime. We shall also meet with a good sprinkling of such as *Noctua*, *Glœa*, *Triphœna ianthina*, *Hadena protea*, *Polia flavicincta*, *Phlogophora*, *Hoporina*, *Miselia aprilina* and *oxycanthæ*, *Xylina*, *Calocampa*, the autumnal *Geometræ*, *N. rostralis*, *S. ferrugalis*, *H. albistrigalis*, *S. hybridalis*, &c.

By day, the scarce *Vanessa Antiopa* has occurred at the ivy-bloom, which is a delight also to other *Vanessæ*, and to *Cynthia*. *Noctuæ* may be collected on ragwort, heather, germander, marjoram, grass, and rush-bloom, after dusk, as they settle on these flowers as at ivy and sallow; but bramble, catchfly, bugloss, and most others, must be watched at dusk, and the moths netted as they hover at the flowers, since they seldom settle freely; and of course the *Sphingidæ* and the species of *Polia*, *Dianthœcia*, *Cucullia*, and *Plusia* must be taken on the wing. The following flowers are very attractive:—

Heather (*Calluna*)—*Cynthia cardui* (by day), *Lithosia complana*, *Agrotis agathina* and *tritici*, *Noctua glareosa*, *Dahlii*, and *neglecta*, *H. dipsacea*, *P. festucæ*, *S. anomala*, *Ephyræ*, *N. viridata*, *S. dubitata*, *C. silaceata* and *testata*, *P. hippocastanaria*, *A. ericetaria*, *H. costæstrigalis*, *C. pinastellus*, *S. pariana (Erica)*, *A. tritici* and *porphyrea*.

Ragwort (on the coast)—*Leucania conigera* and *straminea*, *H. micacea* and *nictitans*, *H. popularis*, C. graminis, C. Hawortbi, L. cespitis,

M. furva, M. literosa, A. valligera, lunigera, tritici, obelisca, præcox, pyrophila, lucernea, cursoria, nigricans, T. ianthina, interjecta, N. glareosa, X. cerago, flavago, and *citrago, S. anomala,* and many *Depressariæ.* NOTE.—Ragwort inland does not appear to be attractive.

VIPER'S BUGLOSS—*M. stellatarum, S. chrysidiformis, N. saponariæ, M. anceps, L. comma, P. serena, A. tincta, advena, P. serena, C. umbratica, H. marginata, A. urticæ, P. orichalcea, V-aureum,* and swarms of common *Agrotes, Leucaniæ, Caradrinæ,* &c.

CATCHFLY (*Silene inflata*)—*S. fuciformis, Leucania comma, M. anceps, A. corticea, D. carpophaga, cucubali, conspersa, A. tincta* and *advena, N. bella, A. urticæ, P. iota, bractea,* and *V-aureum, P. serena;*——(*Silene maritima*), *D. capsophila, Barrettii, cæsia,* and *cucubali.*

BRAMBLE—*H. Janira* and *Hyperanthus, C. Pamphilus* and *Tithonus, A. Paphia* and *Adippe, L. Sybilla, T. W-album* (by day), *Leucania putrescens ?, N. rhomboidea,* and numbers of common *Noctuæ* by night.

GRASSES (especially *Glyceria fluitans*)—*S. anomala, A. tritici, cursoria, valligera, L. impura* and *conigera, N. umbrosa* and *glareosa, T. fimbria, A. gemina, C. Haworthi, M. arcuosa,* and many others.

THE MISTLETOE (male plant)—All the early *Noctuæ* and *Geometræ;* it is even more attractive than sallow.

But besides these, a great number of flowers have their visitors; thus to mention some alphabetically:—

AARON'S ROD—*T. interjecta, N. bella, A. lunosa, X. citrago, E. apiciaria, C. testata,* &c.; APPLE, various species; ARCHANGEL, *M. stellatarum* and *P. sylvanus;* ARBUTUS, *C. cardui, V. Atalanta, P. gamma.*

BARBERRY (holly leaved)—All the early things; BEAN, *Agrotes,* &c.; BERRY-BEARING ALDER, *M. anceps, A. basilinea, A. herbida, N. thalassina, E. dolobraria, Eup. pulchellata;* BILBERRY; BLACKTHORN, *L. polycommata, A. pictaria, H. croceago, T. leucographa, C. chamomillæ, N. ditrapesium* (larva); BUCKTHORN, *S. scoliæforme;* BUGLE, *A. Selene* and *Euphrosyne, L. Arion, M. bombyliformis* and *fuciformis.*

CANDY TUFT, various; CLEMATIS, *L. griseola, C. olivaria, A. rubidata, B. asinalis, B. hyalinalis;* CLOVER, *Colias, A. Lathonia, C. cardui, I. statices, A. sulphuralis, A. luctuosa, H. armigera,* and swarms of common *Noctuæ;* DRYAS OCTOPETALA, *A. minos;* ERYNGIUM; FETID IRIS; FURZE, *H. costæstrigalis;* GERANIUM; GILIA AGGREGATA; GOLDEN-ROD, *Butterflies, Geometræ, S. pariana.*

HEMP (male)—various *Noctuæ;* HEMP-AGRIMONY, *G. C-album;* HERACLEUM, *T. mediana;* HEATH-PEA, *L. sinapis;* HOLLY, *L. argiolus, C. psittacata;* HONEYSUCKLE, *V. Antiopa, C. celerio, S. convolvuli, D. galii, C. porcellus, P. bractea, v-aureum,* and C. umbratica; HOPS, E. fulvago, X. *flavago, and aurago, H. croceago,* N. suffusa, M. typica, A. urticæ.

JASMINE—*C. celerio, M. stellatarum, P. bractea;* KNAPWEED, *V. c-album, A. Paphia* and *Adippe, S. ichneumoniformis* (amongst) *E. ochroleuca* (by day).

LARKSPUR, *M. stellatarum;* LILAC, *D. lineata;* LAUREL; LIME, *Th. quercûs, A. cortica, aquilina* and *ravida, M. furva,* and a great variety of others; LOUSE-WORT, *S. bombyciformis;* LUCERNE, *Colias, P. Daplidice, A. Lathonia,* and various other butterflies, *A. sulphuralis,* &c.; LICHNIS, *A. decolorata;* MARJORAM, *Th. W-album, P porphyralis, A. ornata;* MARYGOLD (French and African); MARVEL OF PERU, *C. celerio, S. convolouli;* MICHAELMAS DAISY, *V. Atalanta,* &c.; MUSTARD, *Th. W-album;* NASTURTIUM, *C. celerio;* ŒNOTHERA (moths at this are caught by the proboscis, also at PHYSIANTHUS ALBENS, a green-house plant), *S. convolvuli,* also at Pysianthus, *C. celerio.*

PASSION FLOWER, *C. nerii;* PETUNIA, *S. convolvuli,* &c.; PHLOX, *S. convolvuli,* &c.; PINK, *C. porcellus;* PORTUGAL LAUREL; PRIVET, *S. myopiformis* and *tipuliformis, N. ditrapezium, T. subsequa;* RAGGED ROBIN, *S. bombyliformis* and *fuciformis, I. statices* and *A. trifolii* (by day), *D. conspersa* (by night); RASPBERRY, *T. batis, L. conigera;* RATTLE, *M. Cinxia,* various *Noctuæ;* REED, *N. lutosa, Xanthiæ;* RHODODENDRON, *S. ligustri, C. porcellus, M. bombyliformis, D. conspera* and *cucubali;* RUSHES, *T. derasa, O. suspecta, N. ditrapezium* and *umbrosa, A. fibrosa, L. conigera* and *pudorina,* and other *Leucaniæ,* with plenty of common *Noctuæ.*

SAGE (wood and garden), the former very productive; SCABIOUS, *M. furva,* &c.; SPURGE, *M. Lucina, S. culiciformis,* and *Myopiformis;* SWEET GALE, *S. sphegiformis;* SWEET WILLIAM, *T. derasa, Plusidæ, C. umbratica;* SYRINGA, *A. pyrophila,* &c., &c.; TEASEL, *N. subrosea.*

THISTLES—*A. cratægi, Vanessæ, Th. W-album, A. Aglaia,* &c. (by day), *C. Haworthi, C. graminis, M. furva* (at dusk); THYME, *L. Arion, A. lonicerœ, H. melanopa,* all *Pyraustæ, E. cingulatis* and *auguinalis* (by day); TURNCAP LILY, most attractive to the *Plusidæ;* VALERIAN (red), *C. porcellus, S. tipuliformis, P. dysodea, A. tripasia;* VERBENA, *D. galii, S. convolvuli, C. porcellus,* &c.

WILLOW HERB, *M. furva, Anceps* and *persicariæ;* WOOD BETONY, *M. fuciformis;* WOOD SAGE, *L. complana, A lucernea, M. furva, C. alsines, H. marginata,* &c.; WORMWOOD; YELLOW BEDSTRAW, *Lithosia caniola* (evening); YELLOW THISTLE, *P. Actæon.*

Other attractions than flowers are as follows:

Peaches, plums, apples, blackberries, especially when burst from over-ripeness.

Yew-berries, the great vanity of *D. rubiginea.* The juicy buds of birch, *white-thorn,* and black-thorn.

The sap which exudes from wounds in oak, birch, and other trees, for *Vanessæ;* perhaps *A. Iris*, and also *Noctuæ.*

Puddles, mud, &c., for *Iris* and other butterflies, *Brephos parthenias*, &c.

Aphides on the leaves of nettles, bean stalks, lime, and many other trees. The secretions of these insects in hot seasons forming the well-known "honey-dew." Sometimes very attractive.

Dead animals, such as stoats, weasels, and cats more particularly. I recollect once starting in company with my friend Piffard to Ongar Wood, with a decomposed specimen of the feline race, intended for the delectation of his purple Majesty; but though we let the cat out of the bag, and H. I. M. evidently smelt our game, we could not induce him to come within reach—perhaps the game wasn't high enough.

Dung of animals. This, as well as the previous, attracting *A. Iris*, which certainly has a depraved taste.

Of Artificial attractions, "sleepy" apples sliced and pinned against trees, over-ripe burst fruit in similar positions, may be named. These are chiefly used as baits for butterflies. Stale beer and also vinegar have been suggested.

Putrid soapsuds have been employed by our French neighbours in lieu of sugar, for they do not find the latter profitable, owing to nearly all the sugar in France being extracted from beet, which being without smell, has but little, if any, power to attract.

Sugar, however, is the great medium employed in this country; there are few natural attractions that can vie with it, and it possesses the great superiority over flowers that the visitors to it come to us from all parts, congregating in a small space, where they are at once plainly visible. Various prescriptions have been extolled for their efficacy, but, as good a basis as any may be made by boiling up equal weights of **foots** sugar and treacle in a sufficient quantity of stale beer to bring the mixture to the requisite consistency; that is, it should not be too thick or it will not "work" well with the brush, nor too thin or it will run away to the ground too quickly, and the upper parts of the patch will dry up; lastly, a small quantity of rum should be added shortly before use—if too much be added, the moths will be too quickly intoxicated, will fall to the ground, and be lost among the herbage. Some collectors think proper to flavour their sugar with ratafia, anise-seed essence of jargonelle pears, or the not easily procured essence of ginger-grass. *Honey is* preferred by some to sugar, but besides being more *costly it is less* efficacious.

The apparatus required for sugaring is varied; the collector must take his choice of what he considers necessary from the following:

A sugar tin with a brush attached to the lid is sold for the purpose, but a soda water bottle, a small gallipot for the reception of a little of the mixture at a time as required, and a brush of about three-quarters of an inch diameter at the bristle end, and carried well wrapped up in brown paper, will answer all ends perfectly.

A lantern. This should be fitted at the back with a tongue which may be slipped into a belt or the waist of the trousers or the vest; or it may be suspended from one's mouth by a piece of wire bent at two right angles, the part between the two angles being encased in a tubular bit of wood of the thickness of a drawing pencil, so that it can be grasped by the teeth; or thirdly, it may be slung round the neck by means of a strap, on the ends of which are fastened two hooks which pass into two triangular rings soldered to the back of the lantern, either of these additions sets a hand at liberty. The front should be of plate glass, for a bull's-eye concentrates the light too much, and scares the flies; a darkening cover is also important. N.B.—Always look to the trimming of the lamp, &c., before starting.

A net for sugaring is best constructed by socketing two "paragon" wires into a Y-piece, and connecting their diverging extremities with a piece of cat-gut, which will readily adapt itself to shape of a tree or other object against which it may be pushed. Bag, as usual, but not very deep.

A catching and pinning box is considered by many indispensable. To make this, a tube of about two inches (or three at least, for *Catocala*) in diameter should be sawed transversely half through at about half-an-inch from one end; in the slit thus formed, a circular valve should be made to work so as to close up the tube if required; the other end should be *firmly* covered with strong open net-work. Then a sort of piston corked at the end should be made to fit the cylinder. For use, the valve is opened, the mouth of the tube clapped over the insect, which of course flies towards the net-work, when the valve ought to be instantly closed; next insert the corked piston up to the valve, open the latter and push the insect against the net-work, pin it through one of the meshes, and then withdraw the piston with the insect stuck upon it, repin properly, and transfer to the collecting box.

A fork formed by three darning needles, driven at the angles of an imaginary triangle eye foremost into a handle, is sometimes employed for impaling the very skittish *Catocalæ* on the sugared trees. With practice, a single darning needle may be used very effectively, but the *readiest way of procuring* them in good condition is to stun them by

striking them down with a battle-dore; when netted, they quickly damage their plumage. The use of the single needle reminds me of the Scotchman, who having dreamt that he had captured a Clifton Nonpareil upon a railing by sticking it with a certain big pin, for years carried the *long* pin about with him in the expectation of meeting with the *Catocala*. At last one day sure enough he saw the Nonpareil sitting on a fence, but horror! he had forgotten his pin. Now you, my reader, would doubtless, under the circumstances, have been dreadfully excited, and have rashly made some absurd attempt to secure the prize, which would, in all probability, have got out of your clutches, with the loss of a few scales. But this was not what our Scotch friend did; he went quietly home, got his pin, returned with it to the spot, and coolly pinned the great Blue Underwing.

A pinning box, the usual complement of chip boxes, and killing bottle, will be required. And lastly, and by no means leastly, *lucifers* must not be forgotten.

Choice of locality. Sugaring may be employed in almost any locality, from the most barren and bleak to the most fertile and sheltered districts; the rides and clearings in woods are favourite places of resort. The heaths, sandhills, mountain sides, fens, under-cliffs, parks, borders of fields, are all productive. We should avoid situations where the foliage is dense. Trees which have been repeatedly sugared are always more profitable than those newly tried, and we should therefore be cautious about rushing off to a fresh spot for the reason that we have been unsuccessful. We should not give up dirty water until we are sure we can get a clean liquid.

Choice of evening. The unfavourable circumstances to be regarded are east wind, or a too boisterous wind, bright moon, unseasonably cold weather, too calm weather, ground fogs, the counteracting effect of certain blossoms and of honey dew, untried districts, abundance of ear-wigs, wood lice, slugs, &c., the condition of air *after* a thunder-storm. Favourable are warm dark nights, clouded sky but the air clear near the earth, previous hot weather, moderate wind blowing steadily in our direction, such as W., S.W., or S., thunder in the air, and even during the continuance of a thunder-storm, for in spite of pelting rain, insects will sometimes swarm at sugar. On such a night I remember counting over 150 of various kinds on two small patches—rather embarrassing! NOTE.—Though moonlight nights are *usually* unprofitable, I once saw Noctuæ swarming at sugar about 1 a.m., when the atmosphere was as *clear as space, and the* luminary of the harvest denomination. N.B.—*Bats and night-jars* are good signs.

Time for Sugaring. Sugar should be got on before dusk, but not too soon before, or its virtues and sweetness will be expended on the desert air; when the first cockchafer or "lousy watchman" booms past us, we should be reminded that it is at once time to begin to lay on our sugar: Many leave their sugared trees for home at too early an hour: it should be remembered that some species fly at one hour, others at another, and that a succession of visitors arrive from dusk to dawn.

Modus operandi. We should sugar at intervals of about ten yards, choosing such trees as have the roughest bark, as oak, elm, and poplar; smooth ones, such as beech, horse chestnut, sycamore, and lime, don't, as a rule, pay. The sugar should be put on these in a long narrow streak reaching from shoulder height down to within a foot of the ground, and should be applied on the sheltered side. When there are no trees in the locality, palings (but they ought to be open ones, or the scent of the sugar will not be wafted away) may be sugared; if these be not present, we may sugar foliage of bushes, reeds, or flowers of ragwort, umbelliferæ knapweed, bramble, thistle stalks, &c., marking the spot in some way that we may not overlook it—pieces of white paper answer the purpose. But in some barren spots not even this class of herbage is present. On the sand hills for instance, the method is to tie tufts of *Ammophila* into knots and sugar these; where the grass is very short we must carry laths or boughs to the scene of operations for the application of our sweets; and if not that, we must e'en content ourselves with sugared rags (conveyed to the spot in tins), laying them out to the best advantage we can, or apply our nectar to the bare stones.

Capturing insects off the sugar may be effected by the pinning box or fork already mentioned, but generally there is no difficulty in boxing them in the ordinary way; that is, take the bottom of the chip box between the thumb and little finger, the lid between the index and third finger, the second finger resting on the top of the lid, then apply at one point a portion of the circumference of the lid to a corresponding part of the box itself:—with a very little practice, the box can be quickly opened and shut with one hand; another way is to put the cyanide bottle under them and tap them in; if they be very skittish, they must be netted or knocked down as they fly off. In examining the sugar, we should shut off the light while approaching a tree, we should then place the triangular net underneath the patch, holding it in position by our knee, and having gently turned on the lantern, proceed to box such moths as may be considered worth taking.

Captures at sugar are too numerous to mention, almost all the night-flying *Noctuæ may be taken* in this way, but a few, such as for example

Luperina, Dasypolia, &c., are more readily attracted by light, while others, as the *Dianthæciæ, Cucullia*, &c., are not to be tempted away from the flowers they frequent.

Besides the *Noctuæ*, however, *Sphingidæ*, such as *C. porcellus* and *Elpenor*, have been known to visit the sugar, the *Lithosidæ* are not unfrequently to be met with, many Geometers and Pyrales are attracted, as well as *Tortrices, Phycidæ, Depressariæ* and other Tineina, not to mention beetles, slugs, centipedes, and mice.

NOTE.—Whilst sugaring one must be on the look-out for other visitors besides *Noctuæ*, for Bos, attracted by our lantern, sometimes puts in an unexpected appearance; and had it not been for suddenly "dousing the glim," on the occasion of a pair of horses coming full gallop at my light, it is more than probable that the "Guide" would never have appeared.

By day, sugaring may be used to attract *Vanessæ* and other butterflies with good chances of success.

Light is a very different kind of attraction; to this insects can hardly be said to come from choice, having once got their sight dazed with the glare, they are impelled to it against their will, this is pretty evident from their sometimes frantic through futile attemps to get away from its influence, and by the quietness with which they settle down in some dark corner.

Street lamps first come under notice, and they may be worked with great profit. The collector should be provided with a small net, of lozenge shape, about 8-in. by 6-in., or at any rate with one of the sides straight, in order that it may be pushed up against the flat glass, the acute and obtuse angles of the implement enabling us to dislodge insects from the corners of the lamp, the handle being of appropriate length. At one of the obtuse angles a sharp semi-circular bend inwards may be made to correspond with the rails of the lamp which are favourite resting places. Chip boxes and killing apparatus as usual, but the latter is rarely required here, for insects which have flown to light are remarkably quiet—seem grateful to change their position for the dark interior of the box.

Some species are visible enough on the lamps, the *Eupithecia*, for instance, with their wings spread to their fullest extent and pressed flat on the glass; various species of *Acidalia, Hibernia, Oporabia, Emmelesia*, and *Scotosia*, as well as *Camptogramma Fluviata* and the *Drepanæ*, the *Xanthiæ also*, and the species of *Cosmia* and *Tethea*, which, by the way, *frequently in* their excitement get inside the lamp to their manifest

detriment. *Catocala nupta* rests on the glass, and, taking its size into consideration, does not require for detection any great amount of careful searching. Several species of *Deltoides*, *Pyralites*, *Crambidæ*, and *Phycidæ*, too, settle on the glass, the latter having an unfortunate propensity for getting inside. Light seems to have a specially powerful attraction for the last four groups, the commoner species being often found on the lamps in numbers, while such plums as *Madopa salicalis*, *Spilodes sticticalis*, and *Pempelia formosa* are occasionally found.

To find all these, the lamps require but little examination, and even others that hang to the uprights, such as *Hemerophila abruptaria*, *Timandra amataria*, are easily enough seen, as also are those species which, whenever they settle, rest with their wings erect, as *Selenia*, *Ennomos*, and *Cidaria miata*.

The real difficulty is to find them when they have chosen the dark outside of the framework, especially underneath, and still more when they have retreated to the supports under the base of the lamp as *Sterrha sacraria* has been known to do. Then great care and circumspection is required in scrutinising the different parts, or otherwise many moths will be passed over. Good eyesight, sharpened by practice, and patience, will meet with the most rewards. If we are in doubt as to the nature of any particular patch which may arrest our attention, and which we may be unable to dislodge, the post must be swarmed in order that we may get a closer sight of it; indeed, the most successful hunters climb every post on favourable nights, holding on by the knees, calves, feet, and one hand, while they box with the other; of course, this requires practice, and is not well adapted for portly or elderly gentlemen—putting ladies out of the question.

Many of the species already mentioned will sometimes take up such positions, and most of the *Noctuæ* do so, when they can make up their minds to leave off tearing round and round the lamp in a frantic and utterly demented manner. Here also *Hepialus sylvinus*, *Pœcilocampa populi*, and *Gastropacha quercifolia*, will sometimes settle, while *Chesias spartiata* folds its wings closely together, as though striving to hide under the narrow frame, and *Pelurga comitata* not being able to do so, hangs on to the bottom.

But those requiring the utmost acuteness of vision, are the *Pseudo-Bombyces* generally upon the darkest parts of the frame, *Peridea trepida* exactly like a patch of mud, *Ptilodontis palpina* resembling a bit of dry bramble stick, and *Petasia cassinea* a bit of chip, while the close resemblance of *Notodonta camelina* and some others to dead and dry leaves is very remarkable. For these little short of actual touching will suffice, but *they are tolerable incentives* to a climb.

Some species, the *Smerinthi* for instance, and *Pygæra bucephala* have an absurd habit of creeping up underneath and resting with their heads just in the holes left to supply air to the lamps, and look as though actuated by curiosity to see what is going on inside; occasionally also *Zenzera æsculi*, *Arctia villica*, and probably most of the night flying Bombyces may be found.

By a wonderful instinct, spiders are constant visitors to, or rather residents at, gas lamps, and they thrive and get fat on so rich a ground.

A notice of ejectment served upon them and promptly acted on will save many a moth from being frightened away and more from being destroyed; but a shapeless bundle in a web will sometimes, by careful unrolling, prove to be a good moth in an almost uninjured state.

Atropos, *convolvuli*, and *galii*, have been known to enter houses attracted by the light, and *celerio* seems to have a fancy for settling down near windows ready to be taken the next day.

Luperina cespitis has been taken not uncommonly by the attraction of the lamps carried for sugaring, *Geometra papilionaria* also, and at times, numbers of *Geometræ*.

The lamplighter is a man with whom we should be on friendly terms;—by making it worth his while to serve us, instructing him as to boxing and selecting the species, and placing a supply of boxes at his disposal, we may often acquire without trouble an abundance of insects. It must be expected that he will at first bring you enough Poplar hawks, and Tiger moths to make a breakfast off, but, if he be an intelligent man, this will soon wear off, and after a time he will know "a good 'un" from "a duffer" as well as you do. Still more advisable is it to secure the services of a lighthouse man, for the chances of getting rare, and even new species are much enhanced, not only by the situation in which these edifices are generally erected, but also by the intensity of the light. A "fiver" per annum would doubtless be a welcome addition to the income of such a man, and would not be badly laid out by anyone having the paper to spare.

Note.—The revolving lighthouses so much in vogue seem to be useless as an attraction for moths. If a steady light is attainable it is impossible to guess at the probable results, for, although the story of the lighthouse on the south coast, from which the light-keeper was obliged to sweep the moths with a broom because they obscured the light is obviously apocryphal, it may reasonably be supposed that in a rich locality very large numbers of moths would be obtained, the great prize *Ennomos [illegible] being* among the possibilities. In such a situation *Lithosia [illegible] has been taken*, also *Agrotis lunigera*, obelisca, agathina, præcox

and *lucernea*, *Mamestra furva*, *Epunda lichenea*, *Dasypolia templi*, *Dianthœcia capsophila*, and *Barrettii*, besides heaps of other good things.

Apparatus for attracting insects to light may be simple or complicated, on a small or large scale. The simplest plan is to place a moderator lamp on a table facing an open window, which looks out on to a likely locality, as a fen, heath, sandhill, or wood for example, on a favourable evening, and then wait with net at hand for visitors. Mr. Stainton considers that a strong light should in addition be placed outside the window, in order to bring the insects within the focus of the inner lamp. This plan, which requires the presence of an operator, was not smart enough for our Transatlantic cousins, and an invention was soon completed by Mr. Glover, of Washington, U. S., which would catch moths all night long without any trouble to the owner. It will be found described in p. 199, Vol. ii, of the *Entomologist's Monthly Magazine*, space will not permit of re-describing it here;—however, I may say that on the same principle a room may be readily fitted up. The procedure would be to first clear out a suitable room of furniture, carpets, everything; and stop up the fireplace, and all chinks and holes, and line, if necessary, the walls and floor with white paper. Then, to the open space formed by raising the lower sash of a window, fit two glass frames (single pieces of glass if possible), slanting back into the room, and forming with one another an angle of 30° or so, that is, they would form that angle, but that they are to be kept about an inch and a-half apart at their room end. These glasses are then to be fixed in position and the sides to be closed in. In the next place, as powerful a light as can be procured, the top and bottom openings of the chimney glass being carefully guarded, should be placed on a table behind the glass apparatus aforesaid,, on about a level with the inch and a-half chink between the glasses—when lighted, the door of the room may be closed, and we may proceed to employ ourselves elsehow, feeling satisfied that the odds against anything which may pass through the glasses finding its way out of the room again are something tremendous.

The small hours are the best for working light—but few insects visit it till 10.30 p.m., after which they begin to come more thickly.

White surfaces, as sheets or other linen hung out to dry, have often been known to attract *S. convolvuli*, for instance. The action is, I expect, at dark similar to that of light, but by day insects doubtless sun themselves on chalk and other white or whitish substances, for the greater amount of heat they thus secure.

Searching *for settled insects* is one of the simplest modes of collecting.

Boles of trees; these should be carefully scrutinised for insects: anything having an approach to a triangular outline, whether of the right-angled or isosceles form, should immediately arrest our attention: the posture of the pugs the collector will soon become familiar with, others sit with their wings much arched, or even erect over the back, and may be best detected by examining the tree trunks in profile. The *Notodontidæ*, *Limacodes*, *Ciliæ*, *Geometræ*, &c., assume these attitudes, and are readily passed over when looked at point blank. Some species among the *Geometræ* prefer the more elevated positions on the trunk, others, as the more Bombiciform Geometræ, the Prominents and Noctuæ are usually found from about 2 to 5 feet from the ground, rarely above 3 feet. *Noctuæ*, indeed, generally ensconce themselves near the foot. On tree trunks early in the morning, and again after noon, some of the *Sesiæ* may be found drying their wings, but they soon jerk themselves off onto the ground, and subsequently take wing; on windy nights, again, numbers of insects may be found on the sheltered side of tree trunks. NOTE.—If we see the empty pupa-cases sticking out from the bark, or elsewhere, it is, of course, a strong presumption in favour of the species being out.

Palings should be sought over from top to bottom; on the top ledge in spring and autumn is the place to look for apterous females, which usually run up to the highest point they can reach soon after leaving the chrysalis, *Cucullia chamomillæ* and *umbratica* secrete themselves under the ledge, and *Cossus* erects himself like a split-off piece at the top corner. The paling itself should then be looked at in such a direction that we can see the angles formed where the pales overlap; and the foot quite at the bottom, especially if there be grass or other herbage growing against it (this being turned down for the purpose), should be examined. In Richmond Park *Larentia multistrigaria* almost invariably occurs at this part, and many *Noctuæ* may thus be discovered in their retreats. The sheltered side of the paling should be selected. The ledges of other structures than palings should be peered under; a favourite hiding-place of *Catocala* is under window sills, copings, &c., outhouses, and barns, should be visited—these places will in the winter afford shelter to hybernating species. As a rule, old moss and lichen-covered palings are best—park fences are better than open palings—but new oak palings are very prolific in the case of *Tineina*,—nor must even tarred fences be despised. The grand time for this kind of work is after a boisterous wind. We will suppose that there is half a gale from the *S.E. to-day, to-morrow* if we can find a fence with a N.W. aspect in a *good locality, such as* Dartford, for instance, we shall find plenty of

sport, for sometimes the fences are smothered with moths. Again on warm days while a stormy wind is still blowing, throngs of small things seek sheltered places, especially such as a wood lies to the windward of. It is therefore of great importance that the collector should make a mental memorandum of the aspects of the fences he visits, and also acquaint himself with the way the wind blows, or, rather, how it blew yesterday evening, in which case he may march off straight to the most productive spots.

Herbage may be examined next; on cloudy days or towards dusk butterflies may be found fast asleep, when they may be readily boxed. It takes a little time for the unpractised eye to get accustomed to the appearance of a butterfly with its wings erect over its back, though, after that, they are not difficult of detection; the "Blues" may thus be got in abundance in their haunts. The little *Psyche radiella*, when not flying, may sometimes be found settled on grass or other herbage, at proper time and place. But at night, after the first flight, certain species, such as *Nonagria*, *Tapinostola*, and *Miana arcuosa*, for instance, may be found, singly and in pairs, settled in abundance on the foliage of their food-plants. To give an idea of the results of such collecting, my friend, Mr. Boswell Syme, and I once took thirteen dozens odd of *Nonagria lutosa* in the space of about an hour, and *Tapinostola Bondii* used to be met in like plenty. Then, most collectors are aware how abundantly the males and females of *H. rupicapraria* occur on the hawthorn twigs and buds. Beside these many other species may be met with settled on foliage after dark by simply looking for them by the aid of a lantern.

Beating is the plan usually adopted for disturbing the tenants of foliage and starting them on the wing. Net in the right hand and beating stick in the left, the operator thrashes away, snapping up in his net such moths as fly out. Where there are two collectors it is a good plan for one to beat and the other to follow at a respectful distance with his net, for insects sometimes require a little time to make up their minds to take flight, and a solitary beater misses a number which dart out from spots that he has passed. If this arrangement be not made, then that collector who lets his comrade go first gets the best of it, which is, of course, just the reverse in paling working. It should be well remembered that it is the leeward side of a hedge or bush which should be beaten; for the insects will be certain to fly out on that side.

Tree beating by means of a long pole is useful for dislodging the Hook-tips and other species, some of which fly in the sunshine, some in early morning, and it is especially serviceable when it is desired to procure females.

Trunk beating by the mallet, as for larvæ (see page 23 ante), is an excellent way of obtaining perfect insects, but the weight of the implement is much against it, and almost as much vibration may be produced upon even large trees by means of a stout cane or newly-cut hazel stick some five or six feet in length, by striking the trunk in such a manner that nearly the whole length will jar upon it at the same moment. This is the plan by which *Tephrosia consonaria*, *extersaria*, and *viduaria*, the *Boarmidæ*, *Aventia flexula*, *Erastria fuscula*, *Eupithecia lariciata*, *pusillata*, *abbreviata*, *dodoneata*, *indigata*, *Hypena crassalis*, and others, may be best obtained in the day-time. In the same way *Lithosia quadra* may be dislodged; but in this case striking the larger branches of oaks, &c., is more productive. NOTE.—The collector must keep his eyes well open, and in all directions around him, for some fall plump down, and others make a bolt of it.

Brushing tree trunks and palings with a leafy little bough, or with a dusting-broom, is a good plan of starting such species as are difficult to see.

Pumping by means of a powerful garden engine is a still better means of dislodging the tenants of a tree, but, unfortunately, though very effective at home, we cannot well apply it on our travels.

Pelting with stones may also be employed with advantage. NOTE.—Of all trees there is perhaps none which harbours so many moths as the yew.

Switching low herbage is a first-rate method of working the perfect insect, especially on rough broken ground. A long switch is passed with a tapping movement from left to right and *vice versa* as we walk along, and by this means we disturb such insects as may be hidden in advance of us. As they start up we can chase and net them, or, better still, first mark them down, for while some, as *A. sulphuralis*, *A. ornata*, *A. gilvaria*, and *citraria*, *Eubolia*, *Aplasta*, *Pseudopterpna*, *Spilodes*, *Madopa*, &c., soon settle again, others, as *Euthemonia russula*, including now and then a few of those already mentioned, if not approached with great caution, will fly up, up, up, until all hopes of securing them are lost. *Brephos parthenias*, by the way, will soar up in this manner, and so, too, will *Fidonia piniaria*, and sometimes even *Psyche*—this, of course, applies in like manner to insects *tramped up* as we walk through herbage of any kind.

Sweeping *is* here mentioned because, though a poor return for the labour in the way of good specimens may be expected, yet an idea

may by it, in some slight measure, be formed of the fauna of the neighbourhood. The great thing to be borne in mind is (that is, if *specimens* be required), not to keep sweeping on regardless of contents, but to examine the net after each two or three sweeps, otherwise no recognisable capture will be found. It is all very well as a sort of "sample taking" of a locality when there is nothing to urge us on to use our wits, but as a method of collecting the perfect insect it must rank very low indeed.

Fumigating and *vaporising* are by many considered profitable modes of collecting from bushes and herbage. The operation will be conducted as recommended for larvæ at page 25, and here we may sometimes take advantage of a bonfire of weeds when the nature of the wind keeps the smoke down.

Blowing upon the trunks, &c., has been adopted with great success by Mr. Barrett. If the weather be windy and not too hot numbers of small species will be found settled on the sheltered sides of trees, and by blowing sharply on the trunk, and at the same time holding the net in a suitable position, they may be driven into it and easily secured. The great majority will of course be *Tineina*, but many *Tortrices* will also be found, as well as *Eupithecia* and other *Geometræ* (such as *ostersaria* and *lichenaria*), which cannot easily be seen on the bark. Even the prominents and other large species, if not blown off, are made to raise their wings, and so become visible.

Fishing out *Acentropus* from off the pond weeds by means of a very shallow net, with a longish handle, is another mode of collecting. In the London district collectors must not mind being asked, "Please Sir, give me all the tiddlers you ketch."

Simply walking about even, and gently disturbing the bushes in a piece of underwood of three or four years' growth is often wonderfully productive of *Geometræ*, *Pyrales*, and *Tortrices*.

Butterfly hunting is generally looked on as simple work enough. It is true that some, such as the Wood white, may be easily run down by a child, but others have remarkable powers of flight. A few, as the Brimstone, resort to the dodge of "doubling" when hotly pursued. The purple Emperor and his attendant knight, *Thecla quercûs*, try to keep out of our reach, others, as *Thecla rubi*, render themselves invisible in some mysterious way. The butterfly hunter should be a cool hand, and *should strike with* precision when the proper moment comes. *He should avoid placing* himself between the sun and the object he

desires to capture, for in that case a shadow will be fatal to his hopes, and he should endeavour to get to windward of his game. Sometimes by stationing himself at a particular spot and striking steadily as the butterfly comes within reach he may do far more execution than could be accomplished by any fleetness of legs, dexterity of arms, and general powers of endurance, for many species have a tendency to return to the same places of call, and to retravel the *routes* previously traversed. The position taken should, if possible, as in a wood for instance, be some narrow gorge, through which the insect, if it comes that way, must pass, or there may be some particular batch of bloom, or even a favourite twig which we may take advantage of. The fritillaries and the white admiral have a tendency to thread their way over and over again through the same rides of woods. The *Vanessæ* will revisit the identical flower (thistle or whatever it may be) most pertinaceously. The Duke of Burgundy will return to the same twig, and so, too, will the Purple Emperor, but for him we shall either have to mount a favoured tree, and with a long-handled net bide our time, or the cumbrous 30-foot handled net may be tried, but the best plan is to find out a locality, in which his majesty occurs, where the oaks are low and pollard-like. The female *Iris* may, however, be sometimes taken in the act of depositing her eggs on sallow, and the male, as already stated, now and then descends from his throne to visit puddles, wet mud, dung, dead animals, &c., he is then, as at all times, very bold, and, if the collector be not flurried, may be cautiously secured. A brilliant idea is to shoot, with dust shot or with a charge of water (as they do Humming birds in S. America), the Emperor as he sits in state! H. I. M. is very pugnacious also, and another dodge is to shy up shining pieces of tin, or stones with bits of white paper attached, when his dignity being wounded, he will sometimes chase the offending object to the ground.

Management.

Female Moths, when found at rest, especially if they appear to have recently emerged from the chrysalis, and still more particularly if the species be rare, or when they have come out in our cages, should, when desirable, be enclosed in gauze-covered cages, and kept, for the purpose of attracting males, till the time of day or night comes round for the species to fly.

When taken on the wing, a female is pretty sure to be im-*pregnated, and in the* event of our wishing to possess ourselves of the *egg, she should be kept* alive and treated as recommended at page 94

ante; indeed, whenever we capture a female, the first question we should ask ourselves is, "*Is it worth our while to breed this?*" for of all modes of getting together insects there is not, without a single exception, one which, for the completeness of its instruction, combined with charming interest and somewhere about cent. per cent. profit return on the outlay in the shape of bred specimens, can in any way compare with breeding from the egg; and we ought to look upon collecting the Perfect insect not so much as a method of procuring cabinet specimens, but rather as the readiest means of obtaining the really valuable *materiel* which, with judgment and care, is the key to a true knowledge of the natural history of the *Lepidoptera*.

Inducing Lepidoptera to pair should be conducted on the principles laid down for laying (see page 5 ante), where similar conditions are required. When it is desired to obtain hybrid eggs, as, say, between *Smerinthus ocellatus* and *populi*, a ♀ *ocellatus* should be placed in a cage with one or more *populi* ♂; and a ♀ *populi* with one or more *ocellatus* ♂ in a separate cage, and these two cages should be kept close together. No more need here be said on this score *verb. sat.*

Although the subjects of stupifying and killing have been touched upon so far as they relate to field-work, a little more is necessary concerning them.

Stupifying insects may be effected by chloroform, though benzole will answer the purpose very well, and is much cheaper, but it should be borne in mind that neither of these agents should be employed to *kill*, or the result will be a rigidity which will render setting very difficult, if not altogether impossible. Generally speaking, we should not permit the fluid to touch the insect operated on, but with large moths it will sometimes be advisable to depart from this rule, in order that the effects may be more speedy, and in their cases we may apply a drop of the fluid to the rostrum of the insect, which will thereby soon be rendered powerless. Again, it must be remembered that moths do not dislike the odour of chloroform if the vapour be applied in a diluted form, and that they usually remain quiet until insensibility causes them to relax their foothold and drop.

The cyanide may be used thus: Tear off a bit of blotting paper about a twelfth of a square inch in superficies, and, holding it with pincers, dip it in a bottle containing solution of cyanide of potassium, allowing it *to absorb little or much* poison, according to the size of the patient; then, *opening the lid of the* box a trifle, drop and shut in the prepared piece of

paper. *Geometræ* and small things should only be stupified thus, then pinned and pricked with oxalic acid. *Noctuæ* should be left till next morning, when they will be found in splendid condition for setting.

Various methods of killing have been advocated. The cyanide bottle already mentioned is certainly the handiest on the field, but at home we shall find the "laurel jar" and ammonia bottle the most efficacious for the purpose of despatching such captures as are brought home boxed.

The ammonia bottle is one of which the mouth is sufficiently large to readily admit the hand, a few knobs of solid sesqui-carbonate of ammonia may be introduced with the pill-boxes and their contents, and if the salt be in good condition (which may be secured by keeping it in a carefully *corked* vessel, mouth downwards), speedy suffocation will result. This plan is most applicable to small insects—*Geometræ*, *Tortrices*, and such like. The insects may, if desired, be taken out in half-an-hour, but they will come to no harm if left over night and removed in the morning; indeed, they will then be in the most delightfully relaxed condition for setting. A word of warning, though, is necessary—it is, that they should be exposed to the air for half-an-hour before proceeding to pin them, otherwise much annoyance may be caused by subsequent corrosion and brittleness of the pins. Another very important thing to remember is, that many of our green insects are much changed by the action of ammonia, and that it is not advisable to submit these to the fumes of it, unless our object be that of surprising the public with the production of orange or other varieties. *L. pectinitaria*, *Eup. rectangulata*, *coronata*, &c., are *varied* extensively by the process. It has been noted that unless the ammonia be carefully kept it will soon lose its virtue—a substitute for this is strong liquid ammonia, but considering that it contains about 700 volumes of the gas compressed into one, the necessity of keeping it cool will be evident. It is quite out of the question for out-door use, but at home a few drops on sponge or blotting-paper may be used for charging the killing-bottle. MEM.—Air the boxes before using again, for a faint smell of ammonia, though insufficient to suffocate, will be quite enough to cause restlessness.

A camphor jar is sometimes employed for killing, but it is not a favourite with many.

To make a laurel jar, procure a glass bottle—the larger the *better—and having* a mouth of such a diameter that the hand may pass *through with ease*; next (in the spring is the best time, for the poison is *more active then*) gather a good supply of young laurel leaves, but to

prevent mildew it is very important that they should not be gathered in the dewy morning, or when the weather is at all wet; then wipe and cut up the leaves into strips, and bruise in a mortar, or pound them well with a rolling-pin, for unless this be done the two principles which go to form the poison (just as with the flavour of the bitter almond), will not act on one another; strew the bottom of the bottle with a layer of the bruised strips, then place on a circular piece of muslin, after that more strips, and so on alternately until the bottle is rather more than a third full, the last layer being muslin or blotting-paper. Into this vessel the boxes containing insects, with their lids slightly opened (or to obviate this trouble an eyelet may be previously let into the lid of each), may be placed, and the mouth closed with a stopper or bung, whichever is preferred. Some stupify their captures with chloroform before using the laurel-bottle. N.B.—An air-tight jar will answer the purpose, and is not so liable to breakage. But it may so happen that, from accident or other cause, we are destitute of killing apparatus, in which case we shall have to kill extempore.

Brimstone matches are to be found in even the most uncivilized districts of these isles. If half-a-dozen of these be lighted and pushed under an inverted tumbler containing the insects to be despatched, suffocation will ensue; but green insects must not on any account be subjected to the process.

If the sun be shining fiercely the insect may be put in a chip box against a window, when it will quickly die.

The flame of a candle or lamp applied to the bottom of a box containing an insect will, in like manner, rapidly destroy life.

A needle made hot by putting one end in the flame of a candle, the other being inserted into the insect, is another barbarous method.

Pinching, when neatly managed, leaves very little evidence of the rough usage, but it requires a good deal of practice before perfection is acquired. The wings of the insect should be got up over the back if possible before the operation, so that the under-side of the thorax may be better got at, but Mr. NORCOMBE used to let the nail of a finger grow long, and with that would kill geometers in his net by bringing them for a moment between the two sides tightly strained together, and then touching the upper side of the thorax sharply with his nail.

For relaxing insects, the laurel bottle, with the addition of a cork lining round the sides, to which the insects are to be pinned, is *very useful, and the* contents will remain in a beautifully relaxed condi-

tion for a considerable period, but it should be recollected that after a time a tendency to grease will be observable, and they should therefore not be allowed to remain too long in the fumes.

A more simple plan may be extemporised for use when on a collecting expedition. We will suppose that having returned to our quarters late from sugaring or some other sort of collecting, we have more captures than we care about setting over night. It will then be found most convenient to kill and pin our captures on to a piece of cork, and on this to float them in a wash-hand basin and cover over with a wet towel, taking care to secure the latter from touching the insects. The moths will be found in a perfect order for setting in the morning. By this means we may relax insects which have already become stiff, though damp sand covered with blotting paper is more generally employed for the purpose, either of these procedures will answer the purpose of a laurel-jar upon occasion, but mouldiness will result unless we are careful to set our captures within a reasonable time, say, four-and-twenty hours, but the sooner the better. N.B.—Heat does not appear to accelerate the relaxing power of damp air.

A plaster of Paris relaxing box, such as bird-stuffers use for skins, answers the purpose capitally.

Pinning, when properly carried out, not only adds much to the appearance of the specimen, but renders setting comparatively easy. Moths from the size of a large *Tortrix* upwards may be gently rested (not squeezed) between the finger and thumb of the left hand, the head looking forwards and to the right; the right hand may then operate with a pin of suitable size; the centre of the thorax should be first pierced and the pin brought out between the coxæ of the third pair of legs. If the medium line has been well kept so that the pin stands upright (the head of it slanting a little forwards in the unset specimen) we should be satisfied; the pin should then be pressed through until, as we compute, there will be sufficient of the pin end beneath to well steady the insect (when set) in the cabinet without the tips of its wings quite touching the papered cork.

Small insects should be placed straightly on blotting paper and carefully pinned without handling; the pins may then be driven through to the required distance on a piece of cork. Direction of the pin the same as above.

Entomological pins are made specially for the purpose, for *Mr. Cooke, of* New Oxford Street, who recommends the following sizes:—

For Sphinges (size of A. Atropos), No. 11, (S. ligustri) No. 12, (Sm. *Ocellata) No. 13.*

For *Bombyces (Cossus)* No. 13, (*P. rubiculosa*) No. 6, (*Clostera*) No. 5.

For *Noctuæ (A. nebulosa)* No. 6, (*Th. batis*) No. 5, (*A. oculea*) No. 8.

For *Geometræ (O. sambucaria)* No. 17, (*E. tiliaria*) No. 15, (*A. asseata*) No. 10.

For *Pyrales (Botys)* No. 15, (*Pyrausta*) No. 10.

For *Tortrices* and *Tineina*, Nos. 10, 18, 19, and 20.

I, myself, consider Nos. 10 and 8 by far the most generally useful pins. No. 10 is always adopted by me where practicable. A proportionably stout and short pin should be used in these days of removing forceps.

It should be remembered that the thoraces of many species are very hard and shiny, and that the pin point must therefore be kept steady, or it will glance off and scratch away some of the plumes. Another thing to be well borne in mind is that some moths will bleed when pinned, and their green or yellow juice must be quickly absorbed by touching gently with a piece of blotting paper, else serious damage may ensue; the orifices both above and below should be looked to for this bleeding.

Perhaps it may also be mentioned here that some insects, especially if killed too soon, eject a coloured meconium which is very damaging if it gets upon any part of their surfaces; but still it is very necessary with some species to despatch them as soon as possible after emerging; for instance, if *Macrogaster arundinis* be kept alive for any length of time, we shall, in all probability, find that it has made use of its long body to sleek down its wings to their utter detriment.

Transmission of Lepidoptera by post. It is worth knowing that by a recent alteration in the postal arrangements, boxes of specimens illustrative of natural history, may be forwarded by pattern post, that is, at a rate double that of book post, or 2d. per four ounces provided that no letter be enclosed. Care should be taken to put in the moths firmly, and also to cross-pin all bodies of even moderate dimensions; the employment of cotton wool under or over the insects much endangers the safety of the legs and antennæ, but there is no objection to fixing "traps" of finely pulled out wool in the four corners of the box to catch anything which may become detached in transit. It is always safest to pack (with wool) the box within another large box, and this again may be wadded before wrapping up; in the last place a buckram (best) or parchment label for the address and stamps should be tied on with twine or thin string.

Postal boxes should be made with the grain of the wood of the

top and bottom running *transversely* to the length by which their strength is enormously increased. In other respects, size, shape, &c., it is a matter of option.

Chip boxes may be strengthened for postal use by glueing an upright bit of wood somewhere about the centre of the bottom, in such a manner that when the lid is closed it rests upon the other end of it; or if nested and shut one in another, their power of resistance is greatly improved, especially if instead of doing up neatly, we roll it up in wool and paper like a ball. Tin boxes are also useful for the service as they cannot well get smashed.

Observation.

It is much to be desired that collectors should observe and enter into their diaries any facts connected with the Natural History of Moths and Butterflies which may come under their notice, or still better, publish them to the world in the Entomological periodicals. The habits of the perfect insect are well worth study: their modes of flight, varying even in the same species according to the object for which it is on the wing; the attitudes assumed when wing-drying, at rest, pairing, laying, feeding; the times of year and day at which the same occur; the nature of localities, longitude, latitude, attitude, soil, vegetation; state of atmosphere, favourable or unfavourable; places of resort and retreat; hybernation; duration of life; tendency to variation; besides a train of other subjects which will suggest themselves for investigation.

NOTE.—Mr. CARRINGTON, of York, has just published a "Lepidopterist's Register," or special diary for the use of the collector.

It is not within the scope of a little work like this to give directions for describing the perfect insect; *that* is a far different thing from taking descriptive notes of ova larvæ and pupæ, which are fleeting things as compared with the perfect insect, and the depiction of which by pen or pencil as opportunities occur, is a source of much valuable information.

Preservation.

Of setting insects there are not only several fashions—high, low, flat, and rounded—which will necessarily modify the process, but different manners of securing the specimens in the position we wish them permanently to assume. Of course, none of these are true to nature—do not represent an insect flying, at rest, or in any other natural *attitude—but they* afford us the best means of examining the various *characters by which* Lepidoptera are usually separated one from another,

and, as it is quite as well to spread them out gracefully, if it be only for the purpose of making the specimens more saleable after our demise, it is advisable that we should take a glance at the methods of effecting this.

The southern plan, carried out by means of what we term "saddles" and "braces," being that with which we are best acquainted, is here given first.

Saddles are corked boards on which the insects are pinned and strapped down in position until they become sufficiently dry and fit for removal. We make them by—in the first place—cutting strips of thin wood of widths varying from three-quarters to five and a-half inches, but all of them of equal *lengths, i.e.*, from ten to fourteen inches, for the convenience of fitting into a setting house, of which notice will be taken hereafter, though, of course the matter is quite optional. On to one of these strips a comparatively thick piece of cork ("*silver*" best), carefully cut at least an eighth of an inch narower, is glued.

[NOTE.—The cork can best be prepared *after* being fixed to the wooden slip, in which case it should not be less than half-an-inch in thickness for the narrowest saddle; but if the collector is satisfied with the width of the cork and board being the same, *or* if the cork be shaped before glueing on to the wood, a much thinner substance of it will be required.]

Then rasp off the upper surface of the cork to a curve corresponding with the section of the circumference of a circle, the diameter of which is, say, two and a-half times the width of the saddle; thus, if we want a 5-inch saddle, the curve should correspond with that of a circle 12½ inches in diameter, a 4-inch with 10 inches diameter, a 3-inch with 7½ inches diameter, a 2-inch with 5 inches diameter, a 1-inch with 2½ inches diameter, a ½-inch with 1¼ inches diameter, and so on; but these proportions are only given as approximate, the curve adopted will depend much on the fancy of the collector, the object here is to show him that the saddles should be manufactured on some system and not anyhow. Having smoothed off the surface with glass paper, next strike the middle line with a chalked string and run a saw down this for the guidance of a curved rat-tail file, such as is used by sculptors, with which a groove of the size suitable for the reception of the body of the insect may soon be hollowed out. N.B.—If the saddle-maker cannot procure the above-named file there is little difficulty in cutting out with a sharp knife a three-cornered piece, and so leaving a groove.

Blotting paper (if any be used at all for the purpose) is best *adapted for covering* saddles, as its soft spongy surface assists in

retaining the wings in position, writing paper is too slippery. But some use transversely-ruled paper to guide them in getting the wings up to the same level on both sides.

Braces may be quickly made as required for use by running a pin through the broad end of a wedge-shaped bit of stiff paper, but to ensure permanence and stability it is a good plan to punch out little circular bits of card, which may be used thus: run the point of a stoutish pin ("short whites" are best) into one, dip it on to some shoemakers' paste, and then apply it to the broad end of the brace and drive it through on a piece of cork; the head of the pin should rather slant away from the small end of the brace in order to give elasticity. For large insects, cardboard braces strengthened with cork at the broad end may be required, or slips of paper may be strapped over the wings, and held in position by a pin at each end, but my own idea is that even the largest insect is best fixed by a mere multiplication of moderate-sized braces. Ordinary music paper is of the best stoutness, stiffness, and elasticity, for most purposes, note paper for the pugs and small things.

A setting bristle will be found invaluable. There are different ways of making it and various materials, such as a bristle, a fibre out of a broom, a very fine needle, quill cut very thin, &c., which have been employed, but not one of them comes anywhere near a cat's whisker, which not only possesses naturally the curve exactly suited to the purpose, but cannot be beaten for elasticity. All we have to do is, after making a pin hole through a small bit of cork, to insert the thick end of the whisker, previously dipped into liquid glue, concave side downwards, and then drive a stout pin through the cork at an angle slightly obtuse to the bristle in order that we may be able to exert greater pressure, if necessary.

A setting needle may be formed of a darning needle, the eye end being driven into a handle, such as a piece of cedar pencil; some prefer to hook or bend the point by bending it in the flame of a spirit lamp.

To set out our captures we first pin them on a suitable saddle, by which is meant one that has a groove sufficiently capacious to admit the body, and rather wider than the expanded wings of the insect to be operated on. Care should be taken to insert the pin with the head slanting slightly forwards and in other respects upright, that is, not [redacted] *to one side* or the other. Then, the legs having been put in [redacted] *and the tongue, if* necessary, drawn out, we begin by setting,

first the wings of one side, the setting bristle point forwards will be placed over them, the point of the pin just resting on the cork behind, the tip touching the cork in front, the head of the pin being steadied by the forefinger, or thumb and forefinger of the left hand; then, placing the setting needle under, first, the fore-wing, we tilt or push it up to the required height, and simultaneously, by simply moving the pin head of the setting bristle forwards, at the same time driving the point slightly into the cork, we put on pressure enough to hold the wing in position; we now withdraw the setting needle and apply a brace or two to the costa. Next, after shifting the position of the bristle a little further back, we repeat the process on the hind-wing, and apply as many braces as we consider necessary. The tips of the wings should always be braced down. And, lastly, we set out the antennæ to our liking and raise the body to its proper position, that is, if the grove happens to be too deep; this may be done by cross pins underneath the body, but better by a brace of suitable length placed under and in the axis of the abdomen, or by little grooved bits of wood of different thicknesses made for the purpose.

Another plan, useful after sugaring, when noctuæ are Numerous and not very precious, and when time is our object, enables us more quickly to get through our work. We procure a fine beading needle—as fine as a hair—the eye end stuck into a lucifer match or a bit of sealing wax, leaving about half an inch of the point exposed. The point of this needle may be partly run through the costa, the fore-wing rapidly raised up to the required level and pegged down with the needle, then, after the application of a brace or two, it may be withdrawn; after that, the hind-wing will have to be treated similarly. Now, if this be done skilfully, and the insects are fresh killed, the little hole will not subsequently be noticed even by the aid of a magnifying glass. But if the operation be unskilfully performed we may get a "notch-wing" where we do not want one, or we may rip up the texture of the wing if the needle be not inserted in or near one of the strong nervures.

NOTE.—Sometimes the fringes get misplaced; by gently blowing upon them they may be restored to position. It is a bad job when any of the cilia gets knocked off.

The northern plan is carried out by cutting off pieces from a saddle made as above in lengths sufficient for setting each a single insect, and these are placed side by side on a strip of wood so that the insects have their *wings relatively* tip to tip instead of, as in the other plan, *being head to tail.* The method of fixing them in position, too, is

different, for pieces of thread of the required length are attached by one end to the woodwork, and after the insects are put in position several turns of thread are wound lightly round the wings, saddle and all, and fastened off in a slit made for the purpose in the wood; with practice this process of setting may be very rapidly conducted.

Rounded setting is preferred by some for the reason that specimens so set out have a more attractive, though less natural, appearance than those prepared as above. There are two methods of carrying it out.

"**Four strap**" setting is one; four similar card braces, rather broad, longer than the length of the insect intended to be operated on, and carefully bent to the desired curve, are all that are required for setting out the wings, this, at any rate, is an advantage; two are first placed at a computed distance with their thin ends looking backwards and towards one another in such a manner that, when the moth is placed over them, the middle of the costæ of both fore and hind wings will rest upon them, then, as the wings are got into position, the other two braces are placed *over* the wings a little beyond the middle of the costa, that is, nearer to the tips than the straps underneath. The elasticity of the costal nervure is sufficient to keep the wings in position.

A rounded saddle is the other way. These are made by first turning a globe of soft wood, as willow, the diameter of the ball being, say, two and a-half times that of the saddle required, or whatever other proportion may be fixed on. Then, slice from off the circumference of the ball pieces of the required size, divide these into two; cut out from the middle of each semicircular piece a width proportionate to the size of the body of the insect the saddle is intended to accommodate. Glue down these pairs of three-corned rounded bits in position to a suitable board, separating them by a strip of cork of the width for the body, and thus replacing the bit of wood cut away.

Flat setting has some great advantages over the ordinary methods, but it is very unpopular in this country, for the very reason that foreign specimens are set in this way, and English collectors are very sensitive on the point of having the authenticity of their captures doubted; and certainly it is not pleasant, after you have made a statement to the effect that you have taken such and such an insect with your own hands, in ——shire, to be told that you did nothing of the sort, for that the specimen *in question* is an undoubted foreigner, or that it is a North American *species, and could'nt* possibly occur here. The method, for those who [illegible] *try it, is simple* enough: a groove for the abdomen is made in a

piece of flat wood, the bottom of the groove being lined with cork; the wings, after being put into position, are kept so by the weight of little flat pieces of glass, instead of by braces or thread.

High setting, though possessing the advantage of keeping the insect very much out of the way of mites, is eschewed in England for a similar reason.

Removing insects from the setting-boards should not be attempted till the specimens are perfectly dry. This will, of course, depend much on the time of year and state of the weather, as well as on the size and nature of the insect. If the abdomen be stiff, the wings are almost sure to be so also.

Quick drying, as in an oven, on the hob, or other hot situation, may sometimes be necessary, as, for instance, when we have to return home from a country trip, and have more saddles stocked with insects than we can manage to convey in our setting-house; but great precautions must be taken first to brace down the tips and borders of the wings, or they may cockle up; secondly, that the heat be not too great; and thirdly, that mice, cockroaches, ants, &c., cannot get at them.

The setting-house is constructed with grooves at suitable intervals for the reception of the saddles. It is usually furnished with a handle at the top to carry it about by. Many combine a store box at the back, and have a part partitioned off for nets, collecting boxes, lantern, sugaring tin, home killing apparatus, larva tins, &c., and a drawer for pins, braces, setting bristles, body supports, removing forceps, pocket lens, field killing apparatus, &c. Ventilation by means of perforated zinc or wire gauze must be attended to, otherwise the insects will not dry quickly. Young hands should be careful to put their captures away as soon as set, lest some mouse, wasp, cockroach, or other vermin should get at them. If there be ants in the house, the only chance is to swing the setting-house, or stand it on a chair, the four legs of which are inserted into gallipots of water.

Resetting.—When a specimen has been badly set, never stretched at all, or has "sprung," we first subject it to the fumes of the laurel jar, or the damp air of the wet sand pan, until it becomes sufficiently limp to manipulate; and then we set it out again to our liking. Insects re-set should be left longer on the setting-boards than those set for the first time. When, in our estimation, they are in a proper state for removal, we should take them off, and, holding them underside up, lightly touch the insertions of the four wings with a mixture composed of white shellac *dissolved in naphtha*, and then strap them down again to the saddle for

a few hours, until the liquid glue, or whatever else we use, has become dry, otherwise re-set insects are almost certain to "spring."

Repairing damaged specimens may be effected by means of a very slight application of prepared gum tragacanth which is nearly colourless and dull when dry; sometimes we may require in addition some backing of tissue paper. Antennæ, head, tails, and even wings of other specimens may be used to supply deficiences. This is all very well for one's own cabinet, but insects so decorated should not be sent away as "fine specimens" in "exchange," or the sender may lie under a possibly unjust imputation.

In Re-pinning care should be taken to place the pin in the old hole, otherwise, in all probability, somebody will accuse you of having a foreigner in your collection. A little gum may be used to prevent the pin from shifting.

To remove grease some pains are necessary. When the insects are small they may be pinned to a piece of cork loaded with lead and sunk bodily in benzole, pure spirits of turpentine, or rectified naptha, and there left from twenty-four hours to a fortnight, when they may be removed, placed on a bed of powdered French chalk (best), pipe-clay, or magnesia, covered over with the same, and left to dry, after which such powder as may adhere must be gently blown off, or cautiously brushed off with a camel's hair or sable brush. With larger insects it is as well to break off the abdomina, number them, and treat them separately. Dr. Wallace recommends that they be first roasted, to start the grease, and then boiled in benzole in a water bath to get it out. If the bodies are very bad it will be necessary to slit them up with a pair of embroidery scissors, remove the contents, and replace with blotting-paper or cotton wool; but, inasmuch as prevention is better than cure, it is best, in the case of those species which we know from dire experience are sure to go greasy, such as *Nonagriæ*, and other internal—or, as a friend of mine appropriately calls them infernal—feeders, to prepare them while the bodies are yet fresh, otherwise we shall not have to wait long before having the mortification of seeing a horrid patch slowly but surely extending itself over the clean white paper of our cabinet drawers, and very difficult indeed to remove when once formed. We may try ironing with a hot iron, a piece of brown paper intervening, and when we *think* we have got it out re-paper the drawers; we may endeavour to soften it by *benzole and sop* it up with pipe-clay, but the probability is that we shall *be unsuccessful*, or at any rate, only partially successful. When, therefore, *from want of* forethought, we have any of our drawers in this mess,

it is best to damp off the paper, and then cut out the whole of the greasy cork, re-cork the parts removed, smooth down, and re-paper. Some, in addition to stuffing, put a little pad of blotting-paper under the abdomen of the specimen.

Mould is another nuisance with which the collector has to deal. The best way is to take the following precautions against its occurrence. Firstly, never place your cabinet or store box shelves against an external wall of a house, nor keep them in a sky parlour. If you live in a terrace, take advantage of your next door neighbour's chimney-stack, and place your cabinet with its back against the corresponding part of your room, raise it a trifle from the ground, that air may pass underneath, and do not let it touch the wall for a similar reason.

Another method is to kyanise each specimen by touching the underside of the abdomen with either a solution of phœnic acid (one part to six of sulphuric ether or rectified spirits), or a weak solution of corrosive sublimate (six grains to the ounce of spirit)—this solution must on no account be used too strong, or the specimens will assume precisely the appearance you are desirous of preventing—that is, they will *look* just as if mildewed; it is therefore best to test the strength of your solution by drawing a streak of it over a piece of black paper, upon which it should leave no mark when dry.

NOTE.—Carbolic acid has very similar properties to those of phœnic acid, and is, of course, very much cheaper. The latter (made from indigo) is, however, that which is most strongly recommended.

Mites are the worst of all the evils we have to contend with. Here stringent preventive measures are most necessary. In the first place, the cabinet or store boxes should be as nearly air-tight as possible; every insect should undergo quarantine before being placed in the collection. The kyanising as above is a great protection; so, too, is high setting. It has been noticed that *Psoci* and *Acari* always attack the insects at the bottom of a box, and leave those at the top alone; it has therefore been proposed to turn the cabinet topsy-turvy, but this has its *drawbacks*. Camphor and benzole both have a great tendency to make insects go greasy. Loose mercury is very objectionable. Insecticides (such as powdered *Pyrethrum roseum*, or Russian tansy) are apt to get about the drawers, and look untidy—oils of Cajuput, Anise, Thyme, Marjoram, Amber, Turpentine, &c., to make greasy marks, if not used with great caution. A good cabinet—quarantine—and kyanising are the things. *Tineæ, Dermestes*, &c., in a collection must be the result of gross carelessness.

Store boxes, of the best make, kept like books in a bookcase, made to resemble books and labelled as to the contents, are far superior to cabinets. They are rarely attacked by mites owing to the upright position in which they are placed; are more readily referred to; are more portable than cabinet drawers (no small advantage if we want to compare our *Eupithæciæ*, *Dicroramphæ*, *Scopariæ*, or other group with some distant collection); and moreover, similar boxes may be added *ad libitum* as we require them for use.

The cabinet demands considerable attention. First in the material of which it is composed, and the young collector must use great caution in making his selection.

The wood *best* adapted for insect cabinets is MAHOGANY; the *worst*, cedar; all such as contain resinous matter should be studiously avoided, for after a year or two the specimens will be utterly ruined by a deposition of little black specks upon them; even in some cases great blebs of turpentiny matter will condense upon the glasses.

The best maker is Mr. STANDISH, whose work always fetches a higher price under the hammer than that of any other maker; though there are several others who can turn out very respectable cabinets. One great merit of Mr. STANDISH'S plan is that every drawer is made by guage-work, so that they can be shifted about to different parts of the cabinet, or indeed to any other cabinet of the same size which he ever made. The immense advantage of this system is that in re-arranging we have only to empty say the last drawer, prepare it, transfer the contents of the first drawer to it, then prepare that which *was* the first drawer and transfer to it the contents of the second, so that No. 40 say becomes No. 1; No. 1—No. 2; No. 2—No. 3; and so on. Some of these cabinets are so true that, when first made, if a drawer is pulled out an inch or so, the pressure of the atmosphere will force it back again.

The favourite number of drawers is forty, which just nicely contain a good working collection of British Lepidoptera.

The size of the drawers. Averaging 18 inches *square* (324 square inches) in superfices—2 in. outside depth—1½in. inside from cork to glass, but collectors must judge for themselves as to the proportions.

Camphor cells may be made to run all round the drawer; this of course adds much to the expense. Sometimes only the front of the drawer is fitted in this manner. When we do not use camphor, it follows that no camphor cells will be required.

The glasses which cover the drawer should be "patent flatted sheet," *such as used by picture* frame makers, and they should be secured in

frames which accurately fit, and flange over, the drawer. If they are properly made, great care is required in removing the glasses, for should this be done too quickly, the wings may be forced off some of the smaller species. A cheaper plan is to drop the glass into a rabbit covered with very narrow velvet ribbon or "chenille."

The cork with which the bottom of the drawer is lined should be of the finest quality, and very nearly, if not quite, a quarter of an inch in thickness, if the cork is not close grained it is best to fix together two pieces each an eighth of an inch thick, for the odds are that if the pin passes through a hole in the top piece it will come against a sound part in the under one; the cork should be glued together so as to form one sheet the size of the interior of the drawers, it should then be well smoothed with glass paper on a "rubber," that is a block of wood or cork; when thoroughly prepared it should be fixed into the drawer and kept in position by weights until the glue is set.

Papering. The paper used is, I believe, technically known as "tea paper." Good qualities are sponginess, even surface, great whiteness without polish. A little alum should be added to the paste to harden it, and a minute portion of bichloride of mercury in solution may be mixed with it for protective purposes if thought desirable.

Repapering necessitates first stripping off the old paper. This may be done by sponging with hot water until the moisture penetrates to the paste and softens it. When drawers have been papered or repapered they may be stood up under-side to a fire to dry.

Whitening is a process which may often save us the trouble of repapering. Oxide of zinc is mixed with milk until a fluid about the thickness of cream is formed; a *very* minute portion of lamp black should be added to increase the whiteness: or some like a slight shade of blue, which may be got by the addition of a little ultra-marine. Having cleared out the drawer and rubbed some oxide of zinc powder into the pin holes, the whitening, on a soft broad brush, should be applied in one direction; when very nearly dry, a "dabber" may be used to obliterate the lines formed by the brush.

Arranging. First cut slips of paper as long as the width of the drawer, paste down one of them on a board of soft wood, on this arrange in order side by side the largest specimen of the largest species in each row. If you do not possess any particular insect reference as to alar expanse must be made to STAINTON'S Manual, or better still, to some friend's collection. When satisfied, put an unattached strip parallel to *the one on the board*, and mark off the points intermediate between the

tips of the wings; transfer and dot off lightly with a pencil the measurements on the paper of the cabinet, first at the top end of the drawer and then at the bottom, otherwise if "the eye" is trusted to, the divisional lines will very likely partake of the slantindicular direction.

Dividing off may be effected in many ways. Ink lines mark the paper so that if any time we have to alter our arrangement the drawers will have to be repapered. Pencil lines are similarly objectionable, but not to so great an extent. The plans by which the paper is not damaged, in case we want to re-arrange at some future time, seem, to my mind, best—First, fine ink lines may be ruled on white paper similar to that by which the drawers are covered, then with an iron straight-edge and a sharp round bladed table knife we may cut off strips of paper each with a middle line; by means of short pin points we can fix this in the position of our pencil marks in the cabinet, and if there be any points where the strip does not fit flatly to the drawer, they too must be pegged down with pin points. Another plan is to rule off and similarly peg down very narrow strips of dull black paper, but this is almost too conspicuous. A third plan is to divide off by means of black silk or cotton, but there is great difficulty in keeping it flat to the drawer, and it shows up any unevenness of surface to an alarming extent. The most scientific is to have no lines at all, but it must be a first-rate collection that will bear this.

In placing the insects in the cabinet, it is usual to put the most typical male at the top of the row, then the other males, and below them the females. Some of the specimens should be set underside uppermost, and should come last in the series.

Tickets made out of thick writing paper by the aid of a punch and having a number corresponding with its history in the diary. In some rare cases, even the whole history itself, should be attached to each specimen. This may be done by writing it in as small a space as possible on a piece of ruled foreign note paper, doubling it up quite small and pinning it through.

Labelling is carried out by cutting up a copy of DOUBLEDAY'S Synonymic List, or STAINTON'S List of British Lepidoptera, the advantage of the former is that it is more scientific and a trifle more recent; of the latter that it facilitates reference to the "Manual," which is by far the best text-book of British Lepidoptera yet published. It need scarcely be noted that family names come at the commencement of a family, *generic at* the commencement, *above* the first species, of a genus; specific *below the species* indicated. They may be fixed by means of pin points *or curved* and stuck down with a minute dab of paste.

Objects for which Men become Entomologists

Science ought to hold the chief place, but science is a very much abused word, and therefore requires to be explained to the beginner. The individual who sits in his library all the year round up to his eyes in entomological dry specimens and drier literature, writing elaborate Latin diagnoses of probable new species, or turning out descriptions of improbable ones, at the rate of so many per hour, is apt to imagine that *his* occupation constitutes Entomology; and, as a consequence, he too often looks down upon the poor fly-catcher with something like contempt; but for all that, the despised collector often, of the two, does the more for science, by which is here meant the acquisition and diffusion of sound knowledge, and not the art of piling up a synonymy for the bewilderment of future generations.

The observer, on the other hand, when his observations are conducted with caution and carefully recorded, is the most scientific; or, in other words, does more than the other two put together to acquire and diffuse knowledge. The true scientific Lepidopterist should combine all these three in one, and should, moreover, be an anatomist and physiologist.

Pursuit of truth, with a love of nature, and a laudable desire to investigate the histories of the wonderful organisms which God has, in his wisdom, created.

Healthful occupation for those who have spare time to devote to a pursuit which leads them, with an object constantly in view, to green fields, country lanes, sunny banks, shady groves, noble parks, and makes them familiar with beautiful scenery.

Emulation—a desire to excel, an ambition to possess the finest collection, to be considered the best collector, to be known as a most accurate observer, or to be handed down to posterity as a great nomenclator.

Acquisitiveness, the feeling which actuates the school-boy to hoard up marbles, buttons, "bacon," birds' eggs, and postage stamps. It is, at any rate, better to gratify this propensity (when we are unfortunate enough to possess it) by collecting, than it is to become a wretched miser.

The good effects of Entomology are numerous; patience, perseverance, and punctuality, are essential for successful collecting; memory, discrimination, and logical reasoning are necessarily cultivated; early rising is encouraged; the mind and body of youth find occupation; temptation *to immoral* pursuits loses its effect; and liberality with

desire to assist brother collectors is generally engendered, sometimes because it is pleasant, at others because it pays better than greediness. On the other hand, it must be confessed, late hours have to be kept; important duties sometimes go the wall, and with certain covetous folk, barter, lying, deceit, and greed gain uncontrolled sway over their contemptible little minds; nor is this the worst, for some who ought to have known better, have not stopped even here, but led on by sordid *amor habendi*, or the ridiculous prices attached to curious varieties and rare British species, have resorted to fraud, forgery, and theft, to enrich their cabinets or replenish their purses.

A Chapter on Colour,

BY W. BUCKLER.

Perhaps it may be well to say a few words on colour by way of hints intended to assist all who make notes in the vernacular without the use of technical words and terms that are not in general application.

In order to convey an exact idea of what we behold on the bodies of larvæ it is necessary to be precise in the description, and more especially so with regard to the terms employed, and to avoid, above all things, the use of any term of comparison that may tend to exaggerate the idea wished to be established.

All ambiguous words, such as *shades* of colour, which, though a common expression, is incorrect, should be strictly avoided, and it will be found more simple, as well as definite, to be confined to the use of the words Colour, Tint, and Hue.

A Tint signifies a weaker compound with white of a normal or pure colour or colours.

A Hue signifies a modification of a colour by the addition of a small quantity of another colour.

The term *Colour* is of general application, and may be used also to express particulars of detail as well.

The primary colours are red, blue, and yellow, and they yield by mixing in equal parts the secondary colours, as follows:

Red and blue form violet.
Red and yellow gives orange.
Blue and yellow produces green.

Although we know theoretically that both black and white are composed *of the* three primitive colours, yet, in describing that which may be dealt *with by actual pigments* or ideas that represent them, we shall do well,

for the sake of clearness, to regard them here as distinct colours, for it is not possible to make either black or white by actual mixture of any pigments that represent the primary colours.

Mixtures of red, blue, and yellow, afford a series of coloured greys, while a mixture of black and white gives a pure grey.

In the coloured greys, according as one or other colour predominates, so we obtain reddish-grey, bluish-grey, yellowish-grey, and where two may predominate, we have greenish-grey, brownish-grey, purplish-grey.

It now becomes necessary to notice particularly the secondary colours—green, violet, and orange. Blue and yellow in equal proportions produce a pure or full green, and according as the blue may be in excess it becomes a bluish-green, blue-green, greenish-blue; on the other hand, if the yellow predominates, so in proportion is obtained yellowish-green, yellow-green, greenish-yellow; these are all the chief steps in the scale but between each exist other gradations which are readily appreciable by the eye, and will be for the observer to describe.

Blue and red in like manner will give pure violet or reddish-violet, pinkish violet, violet pink; or if the blue be in excess, we get purple, dark purple, intense purple.

Red and yellow in equal proportions give a pure orange, and as the red increases, we have reddish-orange, brownish-orange, orange-brown; or the yellow predominating, we pass to yellowish-orange or to orange-yellow.

Hitherto we have spoken of pure colours, the secondary colours, and greys.

We assume pure colours to be the scale of extreme brightness, such as are seen in the spectrum. In nature we see objects of different kinds in various degrees of brilliancy or of dullness, and will now turn our attention to a reduced or broken scale of colours, not absolutely pure, but in relation to each other corresponding in principles.

The blues in them have a very small quantity of red or a little of yellow, still the eye at once recognizes them as blues.

We have familiar instances in *Lycæna Alexis* where the blue partakes of a little red, and in *Corydon* where the blue is broken with yellow.

The reds are sometimes broken with blue as in the red spot at the anal angle of hind-wing of *P. Machaon*, and sometimes with yellow as in *Vanessa Urticæ*, but yet we know them to be reds.

The yellows we find similarly reduced with blue, as we see in the hind-wings of *G. Rhamni*, and again in the case of *Colias Edusa* the yellow is reduced with a small quantity of red.

The primitive colours may often be seen in various objects still *further reduced or broken* by small quantities of the various greys, and

these are often familiarly spoken of as a dingy blue or dull red or a dirty yellow, and the same with black and with white, often mentioned as a rusty black or a dirty white.

The secondary colours, violet, orange, green, are often similarly more or less reduced with various greys, and these, with the combinations above mentioned, form an inexhaustible stock of browns and of other colours of various degrees of brilliancy or of obscurity.

Modern science has furnished the painter with a large range of pigments of endless variety of brilliancy or of transparency, and some of opacity; and the name of one of the earthy or clayey substances has become a very familiar exponent of its rather turbid slightly orange-hued yellow, so that the word *Ochreous* expresses exactly this peculiar kind of yellow.

But in order to define the particular quality of a certain colour, it is necessary to couple a comparison with it, as for instance, primrose-yellow, sulphur-yellow, citron-yellow, &c.

With reds great attention is necessary to express the exact kind of red; this term *red* without any qualification expresses the colour that neither inclines to scarlet on the one hand, nor to pink or rose-red on the other, or in other words partakes neither of orange nor of purple.

One of the most frequent colours to be met with in larvæ is green, but to simply say a larva is green does not convey any definite idea of its actual colour unless the precise kind or quality of the green is mentioned; and here again the terms must be those that are universally understood.

"Bottle-green" used formerly to be a familiar expression, but it is no longer so, as we see bottles of almost every description of green.

"Pea green" is another vague word formerly in use.

Grass-green is better because it calls up a pure full green by our association of ideas with verdant meadows in their prime, but it is really in strictness somewhat doubtful as among the grasses we find various greens.

Some larvæ have skins that are mottled or composed of small portions of two or three colours; others are freckled, that is to say, sprinkled with some one colour over a ground of a different colour.

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